Railway Age Gazette

Including the Railroad Gazette and The Railway Age

DAILY EDITION

Vol. XLVIII. CHICAGO—MARCH 15, 1910—NEW YORK No. 10A.

PUBLISHED DAILY BY

THE RAILROAD GAZETTE (Inc.), 83 FULTON STREET, NEW YORK, on the occasion of the American Railway Engineering and Maintenance of Way Association.

CHICAGO: Plymouth Bldg. CLEVELAND: Williamson Bldg.
LONDON: Queen Anne's Chambers, Westminster.

W. H. BOARDMAN, *President and Editor.*
E. A. SIMMONS, *Vice-Pres. and Treas.* RAY MORRIS, *Sec'y and Man'g Editor*

EDITORS:

W. H. BOARDMAN, *Editor*
RAY MORRIS, *Managing Editor*
B. B. ADAMS
S. O. DUNN
BRADFORD BOARDMAN
ROY V. WRIGHT
G. L. FOWLER
WILLIAM FORSYTH
PERCY S. HILDRETH
W. E. HOOPER
F. E. LISTER
F. W. KRAEGER
H. H. SIMMONS
S. W. DUNNING
CLARENCE DEMING

Subscription, including regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free.

United States and Mexico ..... $5.00 a year
Canada ..... $6.00 a year
Foreign Edition, London ..... £1 12*s* ($8.00) a year
Single Copies ..... 15 cents each

Application made at the Post Office at Chicago for entry as mail matter of the second class.

If mailed from Chicago the postage on this copy of the *Daily Railway Age Gazette* is three cents. Unless the full amount is affixed to the wrappe or envelope, the post office will not forward the paper.

The subjects presented for discussion before the meeting of the western section of the Railway Signal Association at Chicago this year are in contrast to those of a year ago. At that time the uniform plan of signaling as devised by Committee No. 1 was put on trial, as it were, at the bar of the association. That the result was disastrous to the scheme as presented, is a matter of history, but the benefits of such an open discussion of subjects of vital importance to the signaling profession and to the association seem to have been overlooked; for this, the first experiment of the kind, has not since been repeated. Instead, details of various specifications (subjects of endless wrangling) and papers on various signaling and related subjects have since formed the topics for debate. Perhaps the meat of the reason for this state of affairs can be found in the remark of one prominent signal engineer, who said, in substance, that the result of the debate at Chicago in 1909 was the worst thing that could have happened to the association and the profession in general. His reason for this opinion was that the discussion had opened the eyes of the general managers to the fact that the signal engineers of the country were not unanimously in favor of the scheme of signaling proposed, or even nearly so. But this critic overlooked the fact that the object of the association is to seek for, and, if possible, find and publish abroad the best system of signaling, using the word in the broadest sense, that it is possible to devise. A committee is merely an instrument of convenience to further this object and it may very easily happen, as was demonstrated last year in Chicago and this year by the rejection of the report of Committee No. 1 by letter ballot, that the committee membership can be so constituted as not to represent in the ideas and ideals of its members, the ideas and ideals of the whole profession. It seems eminently desirable that the operating department should be more strongly represented on this committee.

A decided sign of health in the Signal Association was shown when the scheme of "neighborhood" meetings for committees was brought out during the morning in connection with the reports of the sub-committees of Committee No. 3. In brief, the plan is to have present at committee meetings as many persons interested as possible from the country adjacent to the place of meeting. The object is to bring out for the use and guidance of the committee the ideas of as many persons as possible. So far this plan has not been generally applied, it being in an experimental stage; but the enthusiastic approval by the people concerned and by the officers of the association, indicates that it will be extended. Mr. Stevens was particularly enthusiastic; he has ordered any of his staff who may be committee members to attend any meeting of his committee when he will not be absent on account of it for more than 36 hours. He has also encouraged all his men to attend as non-members all the meetings possible. The rapid extension of this "neighborhood" scheme will do much to mitigate the feeling which has of late been spreading, that the less discussion there was of committee reports, the better. No such plan, however, can replace in its salutary results the discussion of important committee reports in open meeting of the association.

The morning session of the Signal Association was taken up mainly with reports of committees. The association broke away somewhat from the schedule by discussing at some length the report of sub-committee No. 1 of Committee No. 1 on Standards. This discussion came near to involving the uniform scheme of signaling, but was headed off before any damage could be done. As at the meeting a year ago, there was a marked difference of opinion between the East and the West. Mr. Stevens (Santa Fe), as champion of the opposition, objected strongly to shelving the upper left-hand quadrant, and later to the use of a third arm on interlocking signals. One of the most significant points brought out by the discussion was the fact that a particularly strong committeeman had voted for the adoption of the standards submitted to Committee No. 1 because the majority of the members had done so. It is only too true that the same reason actuates many other members, both in committee and before the association. To many people the fact that a certain thing is endorsed by the majority, or by several prominent members, is an all sufficient reason for their support. In this way a bare majority of one in a sub-committee may influence the action of the whole association. Yet the difficulty with which a busy signal engineer is confronted, in finding time to give association affairs serious thought, is obvious.

The Manual of Recommended Practice of the American Railway Engineering and Maintenance of Way Association bids fair to become the standard guide of American railway engineers. If it is so to be such a guide, great care should be taken in its preparation, and it should be determined at once just what it is to be. For the most part, it is a manual of practice, but it is also in some small degree a sort of text book. For the most part, committees discuss questions of practice in the bodies of their reports and confine their recommendations as to material for the Manual to statements of practice, basing the recommended practice on the facts brought out in the discussion. But some of the committees include statements of facts either proven or to be proven in those paragraphs that are presented for inclusion in the Manual. Sometimes these statements of facts are

paragraphs by themselves, and sometimes they are included with paragraphs stating recommended practice. It is not altogether clear whether this method of presenting matter for the Manual is intentional or is the result of the high pressure under which engineers work. If it is intentional and the association approves of it, then the Manual will become more than a manual of recommended practice; it will become a text book of railway engineering. In this case the practice should be uniform among the committees and the reason for the practice recommended should be included with the statement of the practice. If it is the result of oversight on the part of the committee preparing the report and the association receiving and adopting it, then the result of calling attention to the matter should be elimination of statements of fact—or arguments— and a very careful editing of the material that goes into the Manual. Which is it to be, a text book or a manual of recommended practice?

THE WORK OF THE ASSOCIATION.

It was at the third convention of the American Railway Engineering and Maintenance of Way Association that one of the members present recollects his sitting beside a well-known editor, and noting and remarking the slowness, the unpreparedness, which characterized the opening of the business of the first day. There was, clearly a lack of experience in that particular line of work, convention business. The same member during the tenth convention in 1909 was then very strongly impressed with the effectiveness of the members on the floor, in speaking clearly, concisely, directly to the point. Few bodies of a similar sort, engineering, educational or otherwise, are equally successful. The key to the situation lies, doubtless, in the fact that the railway engineer, or other officer, is perforce trained to present his case to the busy general manager in few words and directly to the point. The habit thus acquired is in evidence in the convention; clearness and brevity prevail. Other points of interest appear if one compares, or contrasts, some of the earlier and later tendencies as manifested in the meetings. At first much time was spent in discussions of phraseology and definitions; much of this is now delegated to the editor, with better results and with economy of the valuable time of the convention. In the earlier meetings there was a far more critical spirit and somewhat of distrust of the opinions and the reports of committees. At the last convention a conspicuous feature was the support given by the convention to the reports of its committees. This was due in part, no doubt, to a higher plane, generally, in the work of committees, but it also involved a change of attitude among the members, an acquired respect for the reports, and a strong trend toward constructive rather than destructive action. In fact, it seemed at times that one could distinguish between speakers who had been regular attendants, and others who were at this meeting for the first time, by the absence or the presence of the destructive attitude of criticism. Several years ago, when a new committee was appointed, one of its prospective members was warned by a colleague on the old committee that "we are lying in wait for your first report to make it lively for you." The early days were marked by a touch of this spirit. Now the convention is disposed to line up against the man with the brick in his hand and ready to throw it.

In his first address President Wallace said, among other things: "Membership is intended to include two elements—the technical and the practical—and it is intended that the technical engineer and the practical railroad man will be of mutual benefit, that the technical man will become more practical, and the practical man more technical, through the interchange of ideas and information which this association is designed to foster." The spirit thus defined is characteristic of the association, although, in fact, few of the members could be relegated to either class. Most of them are well qualified in practical experience and in theory also. This spirit has had the effect of really enlisting in the society's interest the activities both of men in editorial work on railroad publications, and of professors in engineering colleges; and both classes have rendered excellent service in committee work and otherwise. A liberal policy in this direction seems to have been wise. While most of these men may be regarded as representing the theoretical side, most of them are considerably experienced and practical, and they have not proved a burden through quibbling and hair-splitting. Their main value lies in the facts; first, of course, that they are interested, are in earnest; but also that they have a somewhat different point of view and perspective from the active railway operating officer, so that more sides of a subject are brought into view.

It is well understood, of course, that the work of the association is carried on through committee reports, and these reports are becoming more valuable as the years flit by. Nevertheless, there have been, first and last, many instructive papers presented, either independently or as appendices to reports upon subjects which specially appealed to the writers, or to which for some reason they had given special study. A continuance of this practice certainly seems desirable. In another direction, a useful phase of association effort has been in the conduct of experiments. The impact experiments and tests on rails are special examples. Valuable experiments have been made by members of committees on train resistance, although, in general, not directly as committee work. After a time there are likely to develop many lines in which committees of the society could conduct experiments to the advantage of the railways, but which could be carried on only by securing the financial support of the railways themselves. A system of co-operation with the railroads seems altogether appropriate, and the association might well find it good policy to solicit and to foster combined effort in such a direction.

IMPROVEMENTS IN SECTION WORK.

We publish in another column an interesting and important article by C. W. Kouns, about a plan which has been adopted on the Atchison, Topeka & Santa Fe for the reorganization of section work and the application to it of the bonus system. The Santa Fe plan aims to, and should, increase the efficiency of the foreman, and through him the efficiency of the track laborer. A good foreman is hard to find; the increased pay will attract better men and the present foreman will have the incentive to make him learn to be a better man. It may not affect the laborer directly to any great extent. The ordinary Mexican peon is not ambitious. He can live in Kansas, even in winter, on half his present pay. Also, he does not usually stay on the work long enough for the bonus to show fully the results of his individual harder work. If he works 30 per cent. harder than usual for one month, this affects the bonus only to the extent of 2½ per cent., it being divided by 12. It requires some foresight, which only a higher grade of man has, to appreciate the value of working hard for at least a year on the same section and then staying on it to reap the benefit. Most Mexicans do stay six months at least before going back to Mexico, but most of them go home frequently and many do not return to the same jobs. In the mind of the peon, therefore, the bonus system will probably reduce itself in the end to the sim-

plified proposition that on the Western division they pay high wages but you have to work hard.

The Northern Pacific will this spring lengthen sections and use gasolene section cars on the Linton branch of the Dakota division. This branch is 45 miles long and is now divided into four sections, each crew consisting of a foreman and two men. It will be handled in two sections, with a foreman and five men to the section. Another branch of this division, 28 miles long, may later be taken care of with a gasolene car and one section gang.

Another road on which an important reorganization of sections is being made is the Chicago, Milwaukee & St. Paul. An interesting comparison may be made between the Santa Fe's and the St. Paul's methods. The sections of the St. Paul are being materially lengthened. Sections on double-track lines which have been 4 miles long are lengthened to 6 miles. On some branches two sections have been united into one, which may attain a maximum length of 10 miles. In some cases the sections are made longer in winter, when the main work to be done is patrolling to see that the track remains in good condition, than in summer, when there is more actual maintenance work to be done. Instead of the common handcar, the section foreman is furnished with a gasolene power car weighing about 700 lbs., or from 50 to 70 lbs. more than the handcar that it replaces. The foremen's wages are increased $5 to $7.50 per month. Men who three years ago were getting $45 to $50 a month are now getting $50 to $65. The reduction in the number of sections, of course, reduces the number of foremen to be paid. The car costs $200, as compared with an average cost of $38 for the handcars used before. This, of course, increases the investment in and the cost of maintenance of equipment, but the increase in expense due to this and to the higher pay of the foremen is much more than offset by the reduction in the number of foremen to be paid. The amount that has to be paid in wages to a foreman for caring for a given stretch of track is about $30 a month less than had to be paid for the care of the same amount of track when the sections were more numerous and shorter, and the number of foremen to be paid larger. On this theory, enough will be saved in seven months on the wages of the foreman to pay for the car, so that if it only lasts a year there will be a substantial gain by its use. The reduction in the number of foremen makes it possible to eliminate from the service the less competent and thereby raise the average of efficiency. The higher wages paid are also expected to attract a better grade of men than it was possible to get for the lower scale.

The St. Paul management required that the power cars should be so light and simple in construction and operation that they could be as readily handled as a handcar. This requirement has been met. The car used was, on one occasion, when running 25 miles an hour, stopped within 40 ft. and cleared from the track by two men in 20 seconds. The speed at which it can be run saves the section gang about an hour daily in going to and from work. The gang on a long section consists of 12 to 18 men, who are paid $1.50 to $1.75 a day. Assuming a gang composed of 12 men, paid $1.50 each a day, a saving of an hour a day in time means a saving of $1.80 a day in wages. Assuming a gang of 18 men receiving $1.75 each a day, a saving of an hour in getting to and from work means a saving of $3.15 a day in wages. The power car also makes it unnecessary for the men to use their own muscle to get to work, leaving them that much more strength and energy for use after they reach destination. The consumption of gasolene is about 1 gal. for every 27 miles run.

One incident that happened on the St. Paul showed how the speed at which the power cars can be run may be used to good advantage in cases of emergency. On one of the divisions between Chicago and the Mississippi river there was a sudden and violent thunderstorm, accompanied by an excessive rainfall. The train dispatcher called out all the section foremen to patrol the line. Under the rules all foremen work in the same direction, each going to the next telegraph office to report conditions. On this occasion 140 miles of track were thoroughly patrolled by the foremen on their power cars in 20 minutes.

The new method of handling section work is now used on about 200 sections of the St. Paul, having a mileage of between 1,500 and 2,000 miles. It has thus far accomplished all the results that the management anticipated, and probably will be rapidly extended over the entire system.

An important point about motor cars is the value they would have on mountain divisions where the grades are such that the gang cannot pump a handcar up the hills, but has to use pushcars entirely. This means walking, at the maximum, the whole length of the section twice a day in getting to and from work.

THE EFFICIENCY PLAN IN MAINTENANCE WORK ON THE SANTA FE.

BY C. W. KOUNS,

General Manager, Atchison, Topeka & Santa Fe Western Lines.

Some five years ago there was introduced in the shops and roundhouses of the Santa Fe a new method of rewarding labor known as the bonus or efficiency plan. This method has since been extended until about 90 per cent of the time worked in the mechanical department is covered by schedules. From time to time articles have appeared in the "Railway Age Gazette," dealing with the practice and the results of the efficiency plan on the Santa Fe.

The system of paying men a special bonus for extra and unusual effort, in addition to regular daily or monthly wages, has produced such satisfactory results in the mechanical department of this railway that it has been decided that it is desirable to extend it to other departments where it may appear, on investigation, that it can be successfully applied.

The latest extension of the efficiency plan has been to the work of track maintenance, which is carried on by section gangs under the supervision of roadmasters. It is doubtful whether there are many exceptions, in this country or Europe, to the common method of paying section labor on the flat day rate plan. It is obvious that this system of remunerating labor holds out little inducement for special effort or the exercise of special intelligence. A special inducement in the form of dollars and cents is the necessary requisite to getting better work from an organization made up of men such as compose most section gangs.

With the aim of obtaining better co-operation and greater efficiency and economy in track work, the efficiency plan has been introduced on the western lines of the Santa Fe and is now effective on sections 41 to 70, inclusive, of the Western division. Bonus schedules have been prepared under which roadmasters, section foremen and section men will receive, in addition to their regular wages, a special bonus in proportion to the savings effected by their efforts. The Western division comprises 416 miles of track, 151 miles of main line and 265 miles of branch lines. Gangs of from four to eight men care for sections from five to seven miles in length on the main line, but on the

branch lines a much larger territory is taken care of by a single gang. The following schedule is in effect on each of the 30 sections, with individual standards set for each section:

"Section Number..... .....Division.
"For the purpose of encouraging efficiency and economy in the maintenance-of-way, it is proposed to share with section foremen and their crews a portion of the savings effected by their efforts.
"The efficiency of section maintenance is measured by the labor and material charges, separately, which are incurred by the crew that is charged with the care of the section. Labor is measured by the charges to Account 6, per section time book, and material measured by the material charges to accounts 3, 5 and 18 for the section, as kept by the roadmaster, thus:
"(1) Account 3—Ties, 12 months' total.
"(2) Account 5—Other track material, 12 months' total.
"(3) Account 6—Roadway and track labor, 12 months' total.
"(4) Account 18—Roadway tools and supplies, 12 months' total.
"The 12 months' total is the total charge to the account on this section for the 12 months' period ending with the current month.
"Actual labor cost for the current month is item 3 above, divided by 12. Actual material cost for the current month is sum of items 2 and 4 above, divided by 12.
"Standard cost divided by actual cost gives the per cent of efficiency. Reference to the standard efficiency tables gives the percentage bonus earnings.
"The sum of bonus per cents for labor and material is the total bonus per cent allowed to each member of the crew on his regular wages for the month.
"(a) The Standard Labor Cost, Account 6, for maintaining this section, using an ordinary hand car, is $..... per month.
"(b) The Standard Labor Cost, Account 6, for maintaining this section, using a motor section car, is $..... per month.
"(c) The Standard Material Cost, accounts 3, 5 and 18, for maintaining this section with ordinary track spikes, is $..... per month.
"(d) The Standard Material Cost, accounts 3, 5 and 18, for maintaining this section with screw spikes and using a motor section car, is $..... per month.
"Efficiency of section maintenance is computed monthly and bonus earnings are included in pay checks for the month following that month for which the efficiency is computed. No bonus will be allowed in discharge checks for employes leaving the service.
"All extra labor of employes not in regular section gang and material applied by them on the section on account of extraordinary work or repairs are not to be charged against the maintenance of the section, and the charges for such work are deducted from the total expense before computing the efficiency on this schedule.
"Section must be maintained in a condition satisfactory to the inspector, and his approval of the condition of the section must be obtained before bonus is allowed on this schedule.
"The standard herein provided for is based on the average tonnage per day for the year ending with the date of this schedule. When the 12 months' average of the freight ton-miles hauled has increased 20 per cent or more the standard cost will be increased 10 per cent or more proportionally. When the 12 months' average of freight ton-miles hauled has decreased 20 per cent or more the standard cost will be decreased 10 per cent or more proportionally."

The standard costs provided for in items (a), (b), (c) and (d) of this schedule are not shown, for the reason that these allotments are determined for each section separately on the basis of past costs and present conditions.

Attention is directed to the fact that the standard costs fixed for each section refer to present conditions only. The right is reserved to revise the standards whenever conditions are changed. For example, the existing standard costs of a certain section may be based on the expenditure necessary to maintain that section without ballast. Should this section be ballasted with crushed rock, the right is reserved to revise the standard costs to conform to the change of conditions.

If one section was put into first-class condition in every way in the month of September, 1908, the cost of maintaining it during the twelve months immediately following would be at the minimum. At the expiration of a year, or perhaps two years, say in October, 1910, the cost necessary to maintain that section in as good condition as it was from 1908 to 1909 would be materially higher. The standard, however, is based upon the cost of maintaining the section during the year previous to the date of the inauguration of this system. From 1909 to 1910 the cost of maintaining this section increases by reason of conditions prevailing during the previous year. From the beginnng of the year 1910 the cost necessary to maintain the section in the condition it was in during 1908 and 1909 will have so increased, and comparison with the preceding year will show figures so much higher than the standard fixed by the use of first year's figures, that it will be impossible to keep within the standard costs. In such a case as this, the conditions having changed, the standard costs would be subject to revision, if necessary, to make them conform to the change in conditions.

In order to have closer supervision of the quality of the work done on the sections, inspectors are provided, whose duty it is to acquaint themselves thoroughly and frequently with the condition of the individual sections covered by schedules, and the good condition of the sections must be certified to by the inspectors before bonus is allowed.

Item (a) provides a standard labor cost for maintaining a section, using an ordinary handcar. Item (b) provides a standard labor cost for maintaining a section, using a section motor car. For some years the use of gasoline motor cars on the sections, instead of the ordinary handcars, has been contemplated, and various cars were tried. Finally, a special car was designed for the purpose by H. W. Jacobs, assistant superintendent of motive power of the Santa Fe, and two of them were built on the Santa Fe for test purposes. They were thoroughly tried out in actual service on the Western division for several months, and proved altogether satisfactory. A number of these cars have since been built, and as rapidly as they can be secured will be put into service on the sections.*

This car will pull a load of 8,000 lbs., exclusive of its own weight, at a speed of 12 miles an hour. These cars have been used for section track work since July, 1909, without incurring any cost for repairs.

The use of these cars has demonstrated that there are the following adequate reasons for their general adoption:

(1) The car is inexpensive in construction, light in weight and simple in mechanism. Weighing between 800 and 900 lbs., two or three men can quickly remove it from the track or replace it. Little difficulty has been experienced in acquainting the foremen with the proper way to handle it and what to do in an emergency when three or four miles from a station. The car is also strong, having sufficient power to pull itself and a pushcar, both heavily loaded, at a speed of 15 miles an hour.

(2) By the introduction of these cars, the length of the sections, under the care of the same sized gangs as at present, may be increased by at least one-fifth. Thus, about six sections, out of the present 30, on which the efficiency system is installed, will probably be eliminated. Even if the size of the gangs have to be increased in direct proportion to the reduction in number of sections, the saving effected by the elimination of six section foremen will more than pay for all of the cars within two years.

(3) It is found that by the use of these cars the section men work at much greater efficiency. After having helped to pump a handcar for three or four miles, the laborer is by no means fresh for his work. The time required to go to and from work is considerably shorter; and for all of this time the company pays. The use of motor section cars in place of handcars means the substitution of machine power for human power in one more activity connected with railway operation; and wherever this has been done the result has been increased economy and efficiency.

Item (c) provides a material standard for maintaining the section with ordinary track spikes. Item (d) provides a standard cost for maintaining the section with screw spikes and a motor car.

On two divisions the Santa Fe has put in a large number of screw spikes. The cost of maintenance with screw spikes is expected to be considerably less than with the ordinary driven spike. It is not necessary here to go into the details of the economic value of the screw spike, but the necessity of having more liberal cost maintenance

*It is expected to describe this car in a later issue of The Railway Age Gazette.

standards with the driven spike than with the screw spike is self-evident.

The efficiency of section maintenance is based on the cost of labor and material separately compared with the standard cost. The labor cost comprises all the work performed by the crew chargeable to Account 6, as prescribed by the Interstate Commerce Commission. This account includes practically all of the labor used in track maintenance. The material charge includes the cost of all the materials used by the gang; and whether there shall be waste or economy in their use depends on how they are used by the gang. Under this head of materials such items as the following are included: Ties, all track tools (including hand, push and motor cars), fences, crossing planks, bolts, spikes and splices, switch lamps and supplies.

The regular section gangs are not charged with material drawn by floating or extra gangs when such gangs are in their territory. Substantially all new rail is applied by extra gangs, and for that reason is not included in the schedule on which regular gangs work.

A separate schedule is prepared and handed to each section foreman for his information, with the standard cost of labor and the standard cost of material shown thereon. These standard costs are determined for each section on the basis of past costs and existing conditions. One section may be ballasted with crushed rock, while another section may be ballasted with gravel. Such conditions as these make necessary the use of individual standards.

If the standard labor cost be such as will be fair in June, the inclemency of the weather in January may make section work well nigh impossible. The result of this will be that the decreased labor cost for January will cause a very high efficiency, with the resulting bonus earnings. To overcome this difficulty, actual costs are based on twelve-month averages; that is, the actual cost for any one month is the actual cost for the 12 months ending with that month divided by 12. In this way an average is obtained which will at all times take care of variances in monthly costs due to changes in the weather.

Suppose the standard labor cost to be $133. If on the average a certain section is maintained for this expenditure of labor, each member of the gang will receive 20 per cent of his wages as a bonus. Failure to properly maintain the section may work a forfeit of the bonus, but inability to keep the cost down to standard will not necessarily deprive the gang of bonus. Bonus is paid in decreasing amounts as the cost is increased above standard up to a cost 50 per cent above standard, in this case $200, where the efficiency (standard cost divided by actual cost) has fallen to 66.7 per cent., at which efficiency no bonus is paid. The following extract from the standard efficiency table shows this:

Efficiency Per Cent.	Percentage of Wages as Bonus.
66.7	None
70.0	.22
80.0	3.27
90.0	9.91
100.0	20.00
105.0	25.00
110.0	30.00

Efficiency for material is computed in the same manner.

The section men on the Western Lines of the Santa Fe are largely Mexican peons, and the question may be raised whether they have sufficient intelligence to appreciate such special rewards as are outlined above. The section foremen are, of course, in most cases white men, and it is to them that the inducement first appeals. We have a number of Mexican foremen in New Mexico, who are exceptions to the general rule. Through interpreters the plan has been explained to the Mexican employes; and they understand that less loafing, a few extra spikes tightened, a few additional strokes of the spade per hour, the saving of a spike, bolt or plate here and there, means a substantial increase in their regular wages, and they appreciate that. Of many inducements, this is, perhaps, the strongest that can be offered laboring men for increased efficiency.

The question, of course, arises as to whether or not the right-of-way will deteriorate because of the efforts of the foreman to economize. This is a question that always has arisen when innovations have been proposed with particular regard to the economical distribution of expenses. Proper workmanship must be secured by proper supervision. One workman may supervise his own work properly, but the majority of men require supervision. It is for the purpose of making certain that the work on sections will be performed in a thorough manner that inspectors have been appointed, who are to keep themselves thoroughly acquainted with the condition of each individual section. At regular and frequent intervals, each section is thoroughly inspected and, as already stated, if the track has been neglected in any particular, if the section is not in the proper condition, the matter is at once reported to the superintendent, with the result that the gang having that section in charge loses a part or all of its bonus, depending on conditions. In order to bring about an improved condition of affairs it may be necessary to increase the payroll on individual sections. This will reduce the extra earnings provided by the schedule; but regardless of bonus earnings the section must be maintained at all times in proper condition.

The extra earnings of the roadmasters are determined by the average of all their sections. A part of the territory of each of two roadmasters is included in the 30 sections referred to above. The schedule for roadmasters is as follows:

"Roadmasters.....Division.

"For the purpose of encouraging efficiency and economy in the maintenance-of-way, it is proposed to share with roadmasters a proportion of the savings effected by their supervision of the work handled by their section gangs.

"Bonus earnings of each roadmaster are a percentage of his regular monthly wages, and this percentage is an average of the section percentages used for determining bonus earnings of section gangs on his territory.

"For example, suppose that roadmaster 'A' has 10 sections, and that for the month of October the section percentages were as follows: 7, 24, 15, 12, 18, 9, 26, 10, 17 and 24, total 162 per cent. The average per cent. would be 16.2 per cent., and roadmaster 'A' would receive as bonus for the month of October 16.2 per cent of his salary.

"Bonus earnings are computed monthly and included in pay check for the month following that during which they are earned."

The plan for providing extra remuneration for section labor is practically one of profit sharing. The men have an opportunity to increase their total earnings by special effort, and the net cost to the company of maintaining sections is reduced. Some sections which have heretofore been operated by one foreman and six men can now be taken care of by a foreman and four men.

Co-operation is the idea, and this is accomplished by the arrangement of schedules so that the interests of the company and its employees are both served through efficiency and economy in track maintenance.

The Atlantic Coast Line has just completed a 16-lever, Saxby & Farmer mechanical interlocking plant at Dillon, S. C., at the crossing of the North & South Carolina Railway. There will be approach locking mechanical distant signals. All signals will give indications in the upper right-hand quadrant.

The most popular as well as ubiquitous individual at the Coliseum yesterday was Mister. In the course of a stroll around the exhibits he was met at many as twenty times and "Good morning, Mr. ————," was the most frequent salutation.

ROAD AND TRACK SUPPLY ASSOCIATION.

The Road and Track Supply Association is some six years older than the American Railway Engineering and Maintenance of Way Association. The first formal business meeting was held at the Broadway Central Hotel, New York city, September 10, 1894, at which less than 40 concerns were represented.

The original object of the association was to exhibit at, and supply entertainment for, the annual conventions of the Roadmasters' Association of America (now the Roadmasters' and Maintenance of Way Association). Since the first annual meeting of the American Railway Engineering and Maintenance of Way Association in 1900, the Road and Track Supply Association has given most of its time and attention to the latter organization of railway men.

The first president of the supply men's organization was W. W. Salmon, now president of the General Railway Signal Company. W. H. Stearns served as secretary. At the September 14, 1894, meeting the following were elected: President, W. W. Salmon; vice-president, F. A. Johann; secretary and treasurer, W. H. Stearns; executive committee, R. L. Thomas, D. B. Ruffner, Jr., R. J. Davidson, Harry W. Frost and Joseph Hanson.

On October 19, 1895, at a meeting of the association "in the Gents' Parlor of Southern Hotel, St. Louis," W. H. Stearns was elected president, William Goldie, vice-president, and H. W. Frost, secretary and treasurer. In the executive committee, E. G. Fisher and W. H. Elliot succeeded Harry W. Frost and Joseph Hanson.

The officers and executive committee elected in 1895 held over until the Old Point Comfort meeting, September 16. 1897, when the following were chosen: President, E. G. Fisher; vice-president, William Goldie, and secretary and treasurer, Harry W. Frost. The executive committee was changed to include F. A. Ingalls, W. H. Burnham, J. Alexander Brown and H. Elliott, Jr., instead of W. W. Salmon, E. G. Fisher, D. B. Ruffner, Jr., and W. H. Elliot.

At Denver, September 15, 1898, William Goldie was elected president; F. A. Ingalls, vice-president, and J. Alexander Brown, secretary and treasurer; and for the executive committee, E. G. Fisher and L. F. Braine succeeded F. A. Ingalls and J. Alexander Brown.

The 1899 meeting was held at Detroit, September 14. R. L. Thomas succeeded Mr. Goldie as president and H. T. Wallace was elected vice-president. The executive committee was changed by electing W. W. Worthington, William Goldie and F. A. Ingalls in place of Messrs. Braine, Thomas and Burnham.

The next change in the personnel of the Road and Track Supply Association occurred at the Washington meeting of the Roadmasters' and Maintenance of Way Association, October 9, 1901. More than one here at this week's gathering remember some of the enlivening experiences of the Washington convention. That those who were not there may view a likeness of some of the "doings," we reproduce an editorial from The Railway Age of October 18, 1901:

If anyone of the members of the Roadmasters' Association who attended the convention and lived in the National Hotel should be asked what was the most notable feature of the occasion and should answer "Rats!" he need not be convicted of levity offhand. In fact, the matter was serious. The staid and sober members, both of the association and the supply fraternity, seemed to have been selected for the ravages of the rodent. W. E. Clark, of the Continuous Rail Joint Company, displayed to anyone who wanted to see a shoe with a big hole gnawed neatly across the upper. W. L. Douglas, the shoe man, is $3 in, and L. F. Braine $6 out, on account thereof. C. E. Jones, who is almost the father of the association, and as such maintains its dignity so far as such a thing is possible, would have had to attend the first session of the association with but one sock except for his forethought in providing himself with two pairs. The one that was missing when he arose finally turned up overhanging the edge of a rat hole. It is supposed that the animal's strength failed at that point. Another member who had heard of the experiences of Messrs. Jones and Clark, had some difficulty in explaining to his wife in the morning why he had set his shoes on the mantel and hung his socks over the mirror on coming in the night before. The worst of the whole is that, if these were jokes, they would be tolerably tame; but neither are the stories jokes nor were the rats tame. Some of them that were seen appeared to have fraternized with Hooker's division in the 60's.

At the meeting in question R. J. Davidson and F. A. Ingalls were elected president and vice-president, respectively; and the following executive committee was chosen: H. Elliott, Jr., William Goldie, W. W. Worthington, R. L. Thomas, W. E. Clark and J. H. Martin.

At Milwaukee, September 10, 1902, F. A. Ingalls was elected president and William Godlie was for the third time made vice-president. At this meeting J. Alexander Brown, who had served as secretary and treasurer since 1898, was succeeded by the present holder of those two offices, John N. Reynolds. R. J. Davidson and J. Alexander Brown succeeded William Goldie and W. W. Worthington on the executive committee.

The next annual business meeting was held at Kansas City October 15, 1903. Joseph H. Martin succeeded Mr. Goldie and J. Alexander Brown was elected vice-president. The executive committee was changed by substituting the two retiring officers and F. A. Poor in place of J. Alexander Brown, R. J. Davidson and J. H. Martin.

At the September 13, 1904, meeting at St. Louis, the officers and executive committee were reelected; but on September 13, 1905 (at Niagara Falls) the following officers and committee were chosen: President, W. E. Clark; vice-president, John McKinnon; secretary and treasurer, John N. Reynolds; executive committee, J. H. Martin, William Goldie, Sr., William Goldie, Jr., Charles W. Reinoehl, W. F. Schleiter, F. A. Poor and George Stanton.

The time for holding the annual meetings of the association was changed in the fall of 1906 so as to correspond with the dates of the conventions of the American Railway Engineering and Maintenance of Way Association. The next election, therefore, did not take place until March 20, 1907. At that meeting, John McKinnon succeeded Mr. Clark as president and F. A. Poor was made vice-president. The executive committee underwent these changes: W. E. Clark and Orlando Metcalf, Jr., succeeded Charles W. Reinoehl and F. A. Poor.

While there had been much discussion between supply men and members of the American Railway Engineering and Maintenance of Way Association as individuals on the subject of holding the convention and exhibits at some place other than the Auditorium Hotel, the first official action of the Road and Track Supply Association as a body was taken at a meeting on March 19, 1907, when J. H. Martin and F. A. Poor were appointed a committee to confer with the railway association. While the report of that committee was discouraging, the idea was carried forward by the incoming officers and committee until finally, at a special meeting on September 10, 1908, it was decided to rent the Coliseum for the week in March, 1909, during which the American Railway Engineering and Maintenance of Way Association would meet. While the executive committee had not been successful in obtaining official recognition from the railway association, it did get encouragement. The result of that encouragement, combined with a whole lot of well-directed energy, spoke for itself in last year's display at the Coliseum. That the 1910 exhibition would surpass that of 1909 was foreseen a year ago.

The officers and committee, on whom fell the responsibil-

George Stanton.

Robert E. Belknap.

John McKinnon.

W. F. Schleiter, President.

T. W. Snow, Vice-President.

Azel Ames.

John N. Reynolds, Secretary-Treasurer.

A. P. Van Schaick.

OFFICERS AND EXECUTIVE COMMITTEE OF THE ROAD & TRACK SUPPLY ASSOCIATION.

ity for last year's exhibition, were: George Stanton, president; W. F. Schleiter, vice-president; John N. Reynolds, secretary and treasurer; executive committee, John McKinnon, J. H. Martin, William Goldie, Sr., R. E. Belknap, T. W. Snow and Theodore Huss.

We show, on another page, the pictures of nine of the ten men who have borne the burden of this year's trials—and they were more than a few. Those who visited the Coliseum yesterday will readily admit that the incoming administration has been set a pace that is "going some."

William Schleiter, president, is secretary of Dilworth, Porter & Co., Ltd., Pittsburgh, Pa. Vice-President T. W. Snow is manager of the Otto Gas Engine Works, Chicago. John N. Reynolds, secretary and treasurer, is western manager of the Railway Age Gazette.

The members of the executive committee are: George Stanton, sales agent, Cleveland Frog and Crossing Company, Cleveland, Ohio; Robert E. Belknap, Chicago sales agent for the Pennsylvania Steel Company and Maryland Steel Company; John McKinnon, secretary and general manager, Kalamazoo Railway Supply Company, Kalamazoo, Mich.; Azel Ames, in charge of railway department, Kerite Insulated Wire & Cable Company, New York; A. P. Van Schaick, president, W. K. Kenly Company, Chicago; and John W. Duntley, president Duntley Manufacturing Company, Chicago.

RECONSTRUCTION OF CHICAGO RIVER TUNNELS.

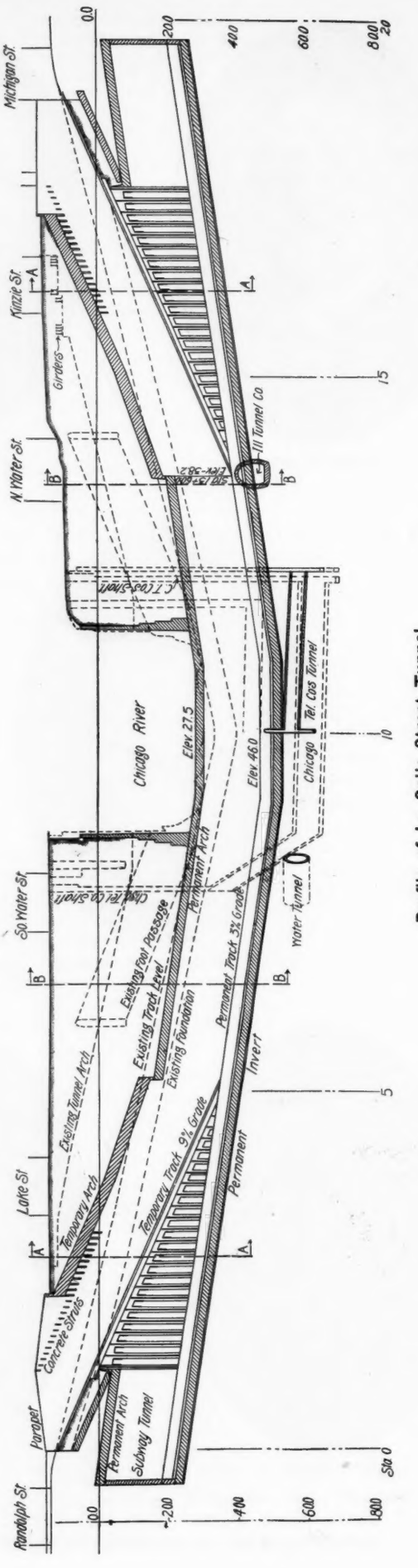
La Salle Street Tunnel.

The first tunnel under the main branch of the Chicago river at La Salle street was built by the city of Chicago in 1869. It has three bores, two for vehicular traffic and one for pedestrians. The work was done under contract by Moss, Chambers & McBean. In 1889 the two bores used by vehicles were slightly remodeled to accommodate the North Side cable cars, which continued to use the tunnel until 1906, when it became necessary to remove the upper portion of the river section on account of the order of Congress to provide a minimum depth of 22 ft. in the river channel.

The tunnel, as reconstructed for the surface cars, had maximum inside dimensions of 20 ft. x 20 ft., the brick arch roof being sprung to an 8-ft. radius. The clearance in the river over the tunnel was about 12 ft. In the accompanying profile, the outline of the old tunnel is shown in dotted lines.

The present rebuilding of the tunnel has been undertaken for two reasons: (1) To allow the North Side surface cars to leave the loop district without crossing the movable bridges, and (2) to provide a connection under the river for the city's future subway system. The removal of surface cars from the four bridges now used by the North Side lines will result in a saving of time for the surface cars, the river boats and vehicles. Cars are frequently delayed for long intervals by an open bridge, and the time consumed in crossing the bridge is always long, on account of the congestion of all classes of traffic. It is estimated that 12 minutes can be saved in the average running time of North Side cars. To avoid long delays to surface cars during the morning and evening rush hours, the city forbids the opening of the bridges for two hours each day, thus blocking all large boats and causing congestion in the river traffic. The existing congestion of vehicles on the bridges would be greatly relieved by the removal of cars, since the vehicular traffic could then use the entire width of roadway.

The new tunnel is to be approximately the same length as the old one, 1,900 ft. The standard twin tunnel section is 38 ft. x 25 ft. over all and each bore is 14 ft. x 20 ft., inside. The tunnel walls are of concrete, thoroughly reinforced with square bars. The clearance allowed in the



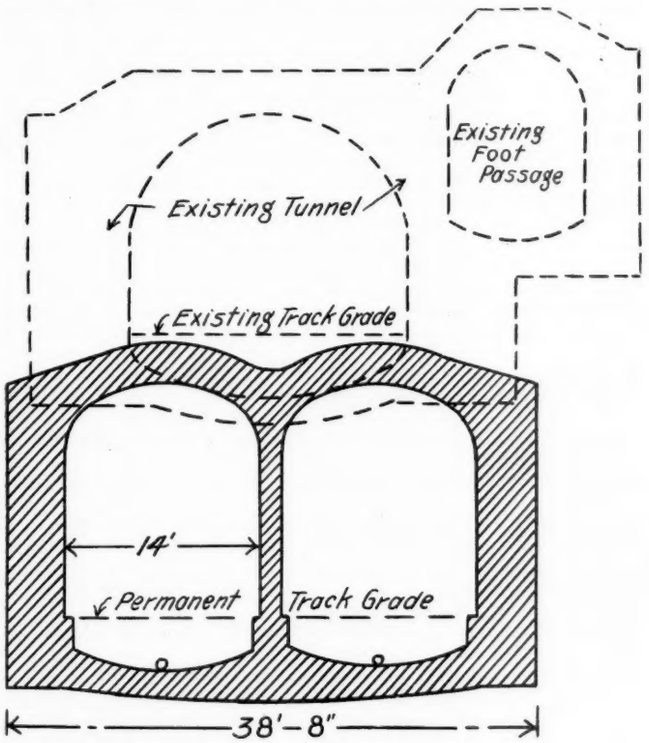
Profile of La Salle Street Tunnel.

river is 27 ft., which makes the foundation about 13 ft. lower than in the old tunnel. The approaches to be used by the future subway are to be made permanent, and a section of the arch roof omitted to allow a temporary wooden trestle to be built for the use of the present surface cars. The grades for the permanent tunnel are, from south to north, 957 ft. of 3 per cent. descending, 193 ft. of level, and 870 ft. of 3 per cent. ascending. The temporary structure for surface cars will be 510 ft. long in each approach and will be on a 9 per cent. grade.

The tunnel is drained by a concrete duct running from an opening in the middle of the river section to a small sump under the pump house on the north bank of the river. Details of the pump installation have not yet been decided on, but it is estimated that there will be very little water in the tunnels except after heavy rains.

The track is to be ballasted, except that the trestle approaches will be open-floor.

The contract for the construction of the tunnel was taken by the M. H. McGovern Company, Chicago, and, with the consulting engineering services of E. C. and R. M. Shankland, Chicago, plans for carrying out the work have been prepared. The work is to be divided into three sections: (1) the river section, which will be built complete and sunk into place, (2) about 370 ft. which will be built in open cut, and (3) the remaining portion, which will be tunneled without a shield by soft earth tunneling methods.

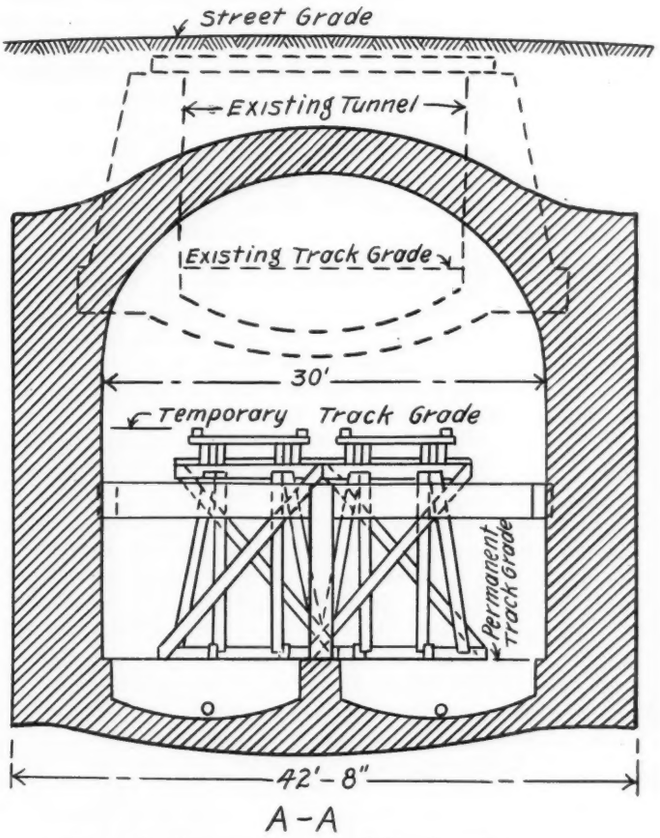


Cross Section on B-B; La Salle Street Tunnel.

The river section is 278 ft. long and has the standard cross section described above. The contract for building this section has been sublet to the Henry Platt Boiler & Machine Company, Chicago, and the work will be done at that company's plant on the river near Twenty-second and Halsted streets, about three miles by river from the site of the bridge. The forms will all be assembled at this place and enough concrete placed to partly submerge the bulkheaded section. The old tunnel foundation in the river will be blasted out, a trench dredged to grade and finished with an orange peel bucket. Two concrete foundations will be prepared, one about 90 ft. from each dock line. The tunnel section will be floated up the river to the tunnel site, anchored near one shore and enough concrete added to just submerge it. It will then be moved to a point over the trench and sunk to final position by admitting water through a water cock. Steel piling will be driven so as to guide the section to its proper bearing on the foundations. The finishing concrete will be placed through vertical pipes extending from above the water surface down to the top of the tunnel section near each end.

The open cut work will be about 45 ft. deep. Lackawanna section sheet steel piling will be used throughout the work, some having already been driven. The ends of the river section will be enclosed in a steel piling coffer dam in which to build the connection with the approach section.

The method to be used in the tunneling work has not been definitely decided, but the following is being considered: A small working heading is to be driven near the bottom of the tunnel section, extending from the open cut to the connection with the river section. This will be braced and lagged and a track laid for removing material and bringing in concrete. The enlarging of this small heading to the cross section of the completed tunnel will be done in lengths of 8 to 10 ft., adjacent workings being at least 25 ft. apart. Each of these short sections will be enlarged to full section and the concrete lining placed and allowed to set before the adjoining section is touched. All excavated material can be removed at the river end of the heading or used to backfill the old tunnel bore, while concrete is being brought in from the open cut end of the heading, the two operations in no way interfering with each other.



Cross Section on A-A; La Salle Street Tunnel.

Washington Street Tunnel.

The old tunnel under the south branch of the river at Washington street is also being rebuilt, considerable work having already been done. The conditions met in this work are similar to those described above, but a very different method is being used. The contract was let to Geo. W.

Jackson, Inc., Chicago, who made the plans for carrying out the work.

A much longer section of the Washington street tunnel could be built in open cut. The west approach, from Clinton street to Canal street, passes under the train sheds of the new Chicago & North Western station and, as work is now in progress on that building, open cut construction was allowable for the entire block. At the east approach a portion of the work between Franklin street and Market street was also done in open cut. The approaches are similar to the ones at La Salle street; provision is made for a future subway system, and the surface line is carried down on temporary wooden trestles.

The remaining work, including the section beneath the river, is being done by soft earth tunneling without a shield. The material is stiff clay, which is easy to handle in this way, and no difficulty is experienced. Two working shafts 9 ft. in diameter were sunk, one on each side of the river, and short sections of tunnel 6½ ft. wide by 7 ft. high were driven in both directions from the foot of each shaft to contain the air locks. The section under the river is to be a single tube, the roof of which was placed when the old tunnel was abandoned. Two headings were driven from the short tunnel containing the air lock, each following the line of what will be the lower portion of a side wall of the finished tunnel. These headings were lagged with 1-in. material, braces being spaced on about 4 ft. centers, and work was carried on from both shafts until the two headings met under the river. Steel forms for concrete were then placed and the lower sections of the side wall placed, almost completely filling the headings. This section of wall was built with two key spaces, one for the wall above and one for the invert.

To place the upper sections of the side walls, headings were driven inside the cross section of the tunnel bore and at the same level as the portion of wall to be placed. Side drifts were then driven and the concrete placed in short sections. The existing roof will be supported directly by the upper section of the wall which is now being placed. When this section is completed, the work will be finished by removing the earth from the bore of the tunnel and laying the invert. The material is excavated with a miner's knife, removed in small dump cars to the shaft, elevated to the surface and dumped into scows in the river. Materials for concrete are handled from cars on a siding to the mixer in wheelbarrows. The mixing is done in a cube mixer and the concrete is dumped into small cars, lowered down the shaft, run back in the tunnel and dumped in place. An air pressure of about 10 lbs. is used in the headings, the pressure at compressors being 12 lbs. Three compressors are used in each shaft house, the ones in the west side being operated by steam and those in the east by electricity.

The work in both tunnels is under the general supervision of Bion J. Arnold, chairman and chief engineer of the Board of Supervising Engineers. George Weston, assistant chief engineer to the board, represents the city. William Artingstall, division engineer for the board, has direct charge of the work in both tunnels.

The Pennsylvania Lines East of Pittsburgh has adopted as standard for the signal installation the scheme outlined by Committee No. 1 of the Railway Signal Association. This includes staggered lights and pointed blades on automatic block signals, and three arms on all interlocking signals.

W. A. Pedalle has been appointed superintendent of construction of the Hall Signal Company.

REGISTRATION—SIGNAL ASSOCIATION.

Adams, Edward L., Chief Signal Inspector, L. S. & M. S. Ry.
Allen, E. A., Signal Supervisor, Northern Pacific Ry.
Ambach, E. T., S. E., Cincinnati, Hamilton & Dayton Ry.
Anthony, C. C., Asst. Signal Engineer, Penna. R. R.
Arkenburgh, W. H., Chief Draftsman, Chicago, Rock Island & Pacific Ry.
Backes, W. J., Ch. Engr., Central New England R. R.
Baker, R. N., Salesman, Bryant Zinc Co.
Banks, W. C., Pres., Banks Electric Manufacturing Co.
Beck, H. M., Engr. Operating Department, Electric Storage Battery Co.
Beck, G. E., Supt. Signals, Lake Shore & Michigan South-
Bender, Fred W., Asst. Supervisor Signals Central Railroad of New Jersey.
Black, E. A., Supervisor Signals, Lake Shore & Michigan Southern Ry.
Boyce, Geo., Supt. Telegraph and Signals, C., St. P., M. & O. Ry.
Boynton, R. D., Lamp Insp., Chicago & North Western Ry.
Brach, Leon S., General Mgr., L. S. Brach Supply Co.
Brown, A., Signal Engineer, C., M. & St. P. Ry.
Brown, E. W., Sales Representative, Edison Manufacturing Co.
Brown, L., General Foreman, Atchison, Topeka & Santa Fe Ry.
Buchanan, F. H., Signal Supervisor, Vandalia R. R.
Buck, H. M., Eastern Representative, Railroad Supply Co.
Cade, J. T., Vice-Pres., Federal Signal Co.
Carr, R. F., Pres., Dearborn Chemical Wks.
Case, D. M., Supt. Signals, Cincinnati, New Orleans & Texas Pacific R. R.
Camp, W. M., Editor, Railway and Engineering Review.
Chenery, E. A., Supt. Telegraph, Mo. Pac. Ry.
Christofferson, C. A., Sig. Eng., Nor. Pac. R. R.
Church, H. M., Div. Engr., Baltimore & Ohio R. R.
Churchill, Wm., Corning Glass Works.
Chambers, Frank R., Jr., Vice-Pres., Duplex Metals Co.
Clausen, L. R., Sup. Chicago Division, C., M. & St. P. Ry.
Clement, S. B., Ch. Engr., Temiskaming & Northern Ontario Ry.
Cogswell, C. P., Jr., Representative, Railroad Supply Co.
Corey, Fred B., Engineer Railway Signals, General Electric Co.
Cotton, C. A., Asst. Signal Supervisor, Atchison, Topeka & Santa Fe Ry.
Combs, Harry, Signal Insp., Lake Shore & Michigan Southern Ry.
Condit, E. A., Jr., Representative, The Rail Joint Co.
Dane, G. W., Supt. Interlocking, South Side Elevated R. R. of Chicago.
Daves, Wm., Special S. E., Chicago Great Western Ry.
Dawley, W. M., Engr., Erie R. R.
Dayton, Clarence A., Assistant Engr., D., L. & W. R. R. Co.
Dean, A., Gen. Mgr., Federal Sig. Co.
Decker, J. R., Signal Supervisor, Michigan Central R. R.
Delavie, F. J., Mgr., Battery Zinc Dept., Grasseli Chemical Co.
Denney, C. E., S. E., Lake Shore & Michigan Southern Ry.
Dodd, E. B., Sig. Supvr., M., St. P. & S. S. Marie Ry.
Dodgson, F. L., Cons. Engr., Gen. Ry. Sig. Co.
Doxsee, C. F., Signal Foreman, Chicago, Rock Island & Pacific Ry.
Drake, Caleb, Supvr. Sigs., C. & N.-W. Ry.
Drake, W. E., Inspector of Signals, Wabash R. R.
Eck, W. J., E. E., Southern Railway.
Ellis, E. F., Supervisor Signals, Cleveland, Cincinnati, Chicago & St. Louis Ry.
Elliott, W. H., S. E., New York Central & Hudson River R. R.
Everett, E. A., Sig. Engr., Mich. Central.
Foale, H. J., S. E., Wabash R. R.
Folley, E., Asst. Signal Supervisor, Chicago & Eastern Illinois Ry.
Foster, W. E., Western Manager, U. S. & S. Co.
Front, R. E., Signal Engr., St. L. & S. F. R. R.
Fugina, A. R., Asst. S. E., Chicago & North Western Ry.
Gillingham, W. J., Jr., Resident Mgr., Hall Signal Co.
Grant, E. C., Signal Supervisor Union Pacific R. R.
Green, R. E., Supvr. Electric Signals, M. C. R. R.
Hall, G. L., Vice-Pres., Q. & C. Co.
Harkness, W. E., Sales Engineer, Western Electric Co.
Hartley, L. C., S. E., Chicago & Eastern Illinois Ry.
Hauser, J. A., Supvr. B. and B., C., C., C. & St. L.
Hickson, C. W., Signal Insp., Pennsylvania Lines West.

Hiles, Wm., Signal Insp., Cleveland, Cincinnati, Chicago & St. Louis Ry.
Hovey, M. H., Wisconsin Ry. Comm., Great Northern.
Hovey, W. G., Sales Dept., Hall Signal Co.
Howe, W. K., Chief Eng., Genl. Ry. Signal Co.
Hudson, E. E., Mgr. Sales, Edison Manufacturing Co.
Jacob, Frank E., Signal Engineer, C. & W. I. R. R. Co. and Belt Ry. Co. of Chicago.
Johns, C. W., Asst. Engr. M. of W., Chesapeake & Ohio R. R.
Johnson, Robt. C., Asst. Signal Engineer, N. Y. C. & H. R. R. R.
Johnson, T. L., Supt. Signals, Delaware, Lackawanna & Western R. R.
Johnson, W. M., Jr., Trainmaster, Bessemer & Lake Erie Ry.
Kelloway, C. J., Signal Engr., A. C. L. R. R.
Kelly, A. J., Supvr. Sigs., Big Four R. R.
Kimbell, E. E., Representative, General Electric Co.
Kinch, W. M., Signal Engr., Lutz-Lockwood Mfg. Co.
Kinder, James F., Secy. Duplex Metals Co.
Klemm, W. J., Signal Maintainer, Pere Marquette R. R.
Kolb, E. W., Sig. Engr., B., R. & P. Ry.
Krum, Paul, Light Insp., Lake Shore & Michigan Southern Ry.
Kyle, W. T., Representative, Duplex Metals Co.
Lane, W. H., Chief Engineer, Hall Signal Co.
Launbranch, M. E., Sales Engr., U. S. Electric Co.
Lee, Frank, Div. Engr., Canadian Pacific Ry.
Lepreau, F. J., Salesman, Edison Manufacturing Co.
Lomas, H. F., Asst. S. E., Illinois Central R. R.
Lorenz, J. N., Signal Engineer, Central Electric Co.
Lowry, H. K., Asst. S. E., Chicago, Milwaukee & St. Paul Ry.
Lutz, T. E., Supervisor of Signals, Cleveland, Cincinnati, Chicago & St. Louis Ry.
Mack, E. E., Asst. Supervisor, Chicago & Eastern Illinois Ry.
Mann, B. H., Signal Engineer, Mo. Pac. Ry.
Mann, L. R., Supervisor Signals, Missouri Pacific Ry.
Manuel, W. N., Supt. of Sigs., G. R. & I. Ry.
Marshall, E. L., Chemical Engineer, National Carbon Co.
McKeen, A. H., Signal Engr., O. R. & N. Co.
McWain, W. J., S. E., Pere Marquette R. R.
Moffett, M. H., Asst. Sales Mgr., National Carbon Co.
Miskelly, Sam, General Signal Inspector, C., R. I. & P. Ry.
Moore, A. G., Chief Draftsman, I. C. R. R.
Moore, P. W., Gen. Mgr., Railway Specialty & Supply Co.
Morris, D. R., Signal Inspector, I. C. R. R.
Nutting, A. G., Lamp Insp., Chicago, Rock Island & Pacific Ry.
Oglesby, E. R., Div. Repairman, Chicago & Eastern Illinois Ry.
Oppelt, J. H., Supervisor Interlocking, New York, Chicago & St. Louis Ry.
Osgood, J. O., Ch. Engr., Central R. R. of New Jersey.
Parrish, F. J., Engr. M. of W., Kentucky & Indiana Bridge & R. R. Co.
Patenall, F. P., S. E., Baltimore & Ohio R. R.
Patterson, H. D., Representative, Lauder & Patterson.
Patton, George J., Supervisor Signals, Delaware, Lackawanna & Western R. R.
Peabody, J. A., S. E., Chicago & North Western Ry.
Peck, J. W., Gen. Sig. Insp., Union Pacific R. R.
Phinney, R. M., Asst. Engr., Signal Dept., C. & N. W. Ry.
Poor, C. O., Genl. Supt., General Ry. Signal Co.
Poor, F. A., Western Sales Agent, The Rail Joint Co.
Pry, E. B., Signal Insp., Pennsylvania Lines West.
Ragland, R. R., Supervisor Signals, Mo. Pac. Ry.
Raymer, I. S., Asst. S. E., Pittsburgh & Lake Erie R. R.
Relph, E. J., Supt., Massey Batt. Co.
Rhea, Frank, Genl. Electric Co.
Rose, L. S., S. E., Cleveland, Cincinnati, Chicago & St. Louis Ry.
Rosenberg, C. C., Consulting S. E.
Rudd, A. H., S. E., Pennsylvania R. R.
Salmon, W. W., Pres., General Railway Signal Co.
Sconce, E. M., Signal Foreman, Chicago & Eastern Illinois Ry.
Seaman, J. C., Signal Inspector, L. S. & M. S. Ry.
Shaver, A. G., Signal Engineer, C., R. I. & P. Ry. Co.
Smith, F. G., Signal Supervisor, Chicago & Eastern Illinois Ry.
Smith, E. B., Spl. Sig. Inspr., N. Y. C. & H. R. R. R.
Smith, F. C., Salesman, American Conduit Co.
Smith, M. E., S. E., Delaware, Lackawanna & Western R. R.
Spafford, James H., retired.
Spencer, C. H., Engr., Washington Terminal Co.
Sperry, H. M., Sales Manager, General Ry. Signal Co.
Spicer, V. K., Canadian Manager, Union Switch & Signal Co.
Squire, Willis C., Consulting Engr.
Stephens, Charles, S. E., Chesapeake & Ohio R. R.
Stevens, Thos. G., Sig. Eng., A., T. & S. F. R. R.
Stradling, E. G., Signal Insp., Chicago, Indianapolis & Louisville R. R.
Talbert, W. W., General Foreman, Union Switch & Signal Co.
Thomas, L., Res. Mgr., General Railway Signal Co.
Trout, G. W., Signal Supvr., C., R. I. & P. Ry.
Unger, O. R., Signal Supervisor, Mo. Pacific Ry.
Warren, S. D., Signal Inspector, C., M. & St. P. Ry.
Weld, H. K., Asst. Sales Rep., McRoy Clay Works.
ern Ry.
Wentworth, C. C., Prin. Asst. Engr., Norfolk & Western R. R.
Whitcomb, F. E., Eng. of Maint. of Signals, Boston & Albany.
Wiegand, F. B., Asst. S. E., Lake Shore & Michigan Southern Ry.
Wight, S. N., Signal Inspector, L. S. & M. S. Ry.
Wilby, R. L., Asst. Engr., Toledo, Peoria & Western Ry.
Wiley, J. R., Western Mgr., Standard Underground Cable Co.
Willis, W. H., S. E., Erie R. R.
Wilson, A. G., Mgr., Hanlon & Wilson.
Winans, E., Chief Draftsman, Atchison, Topeka & Santa Fe Ry.
Whitcomb, L. L., Supervisor Signals, Lake Shore & Michigan Southern Ry.
Workman, W. S., Signal Foreman, Pennsylvania Railroad Lines East.
Wrecks, H. T., Secretary, Wire Inspection Bureau.
Wuerpel, M., Asst. Gen. Mgr., General Railway Signal Co.
Wyman, C. L., Sales Engineer, Millard Storage Battery Co.
Young, H. W., Sig. Maintainer, Chicago & North-Western Ry.
Young, John V., Supt. Signals, Boston & Maine and Maine Central Railroads.

EIGHT-TRACK SCHERZER BRIDGE.

The bridge now being built over the Sanitary and Ship canal, at Campbell avenue and Thirty-first street, Chicago, is composed of four double track single leaf Scherzer rolling lift bridges, placed alternately side by side.

It will carry four tracks of the Pittsburg, Cincinnati, Chicago & St. Louis, two of the Chicago Terminal Transfer and two of the Chicago Junction Railway. The bridge is being built and paid for by The Sanitary District of Chicago, under

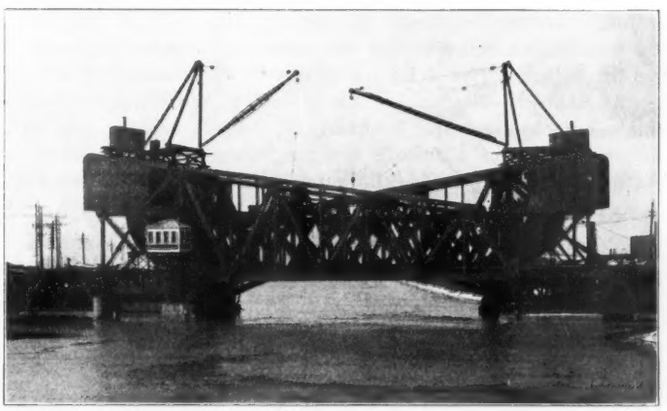


Fig. 1. Progress Work on Bridge.

an agreement with the railway companies to provide a moveable bridge of an efficient design subject to their approval. The Sanitary District also pays the railways such a sum of money as will draw interest sufficient to pay the expenses of maintenance and operation of the bridge.

Competitive designs for the bridge were first invited in 1898, and from the plans submitted at that time, those by the Scherzer Rolling Lift Bridge Co., Chicago, were selected. Contracts for the substructure were let to McArthur Bros., and for the superstructure to Pencoyd Iron Works, Philadel-

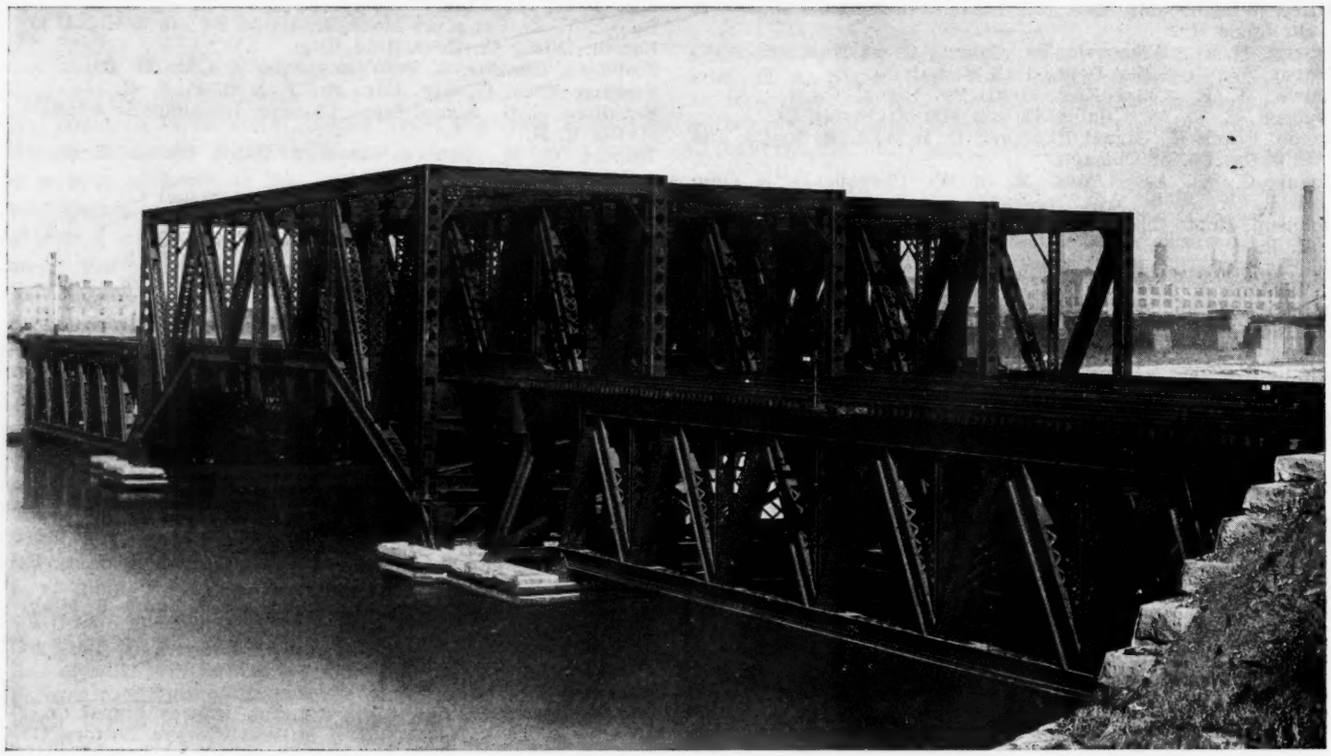


Fig. 2. Fixed Span Over Sanitary and Ship Canal Being Replaced by Eight-Track Scherzer Bridge.

phia, Pa. The bridge was built and placed in service in 1901. However, only those portions of the superstructure necessary to carry the moving loads when acting as a fixed span were erected at this time, and the structural parts and machinery required to make the bridge movable were to be furnished later when it was necessary to open the canal to navigation. Fig. 2 shows the bridge as first placed in service. The part constructed formed four three-hinged arch spans; when completed for operation as a movable bridge, each span was to be a double leaf rolling lift bridge.

When plans were made in 1908 to open the canal to navigation, it seemed advisable to abandon the original plan for the Campbell avenue bridge and substitute a single-leaf rolling lift bridge. The Scherzer company was contracted with by the Sanitary District for a new design, providing for four single-leaf, double-track Scherzer rolling lift bridges, placed side by side, the alternate bridges being supported at opposite ends to allow the minimum spacing between tracks.

Fig. 3 shows the plan of the bridge and Fig. 1 its location with reference to the canal and adjacent railway tracks.

The bridge crosses the canal on a skew, the intersection angle being about 68 deg. The span is 154 ft. center to center of bearings; width of each bridge, 29 ft. 1 in. center to center of trusses; clearance above Chicago datum, 16 ft.; and clear width of channel for navigation, 120 ft. The waterway is increased by an 89 foot channel under each approach span. These approach spans are the deck trusses which were placed when the first bridge was built.

The foundations as placed for the old bridge are used for the new with the exception that it was necessary to place concrete cylinders behind the piers to support the end of one of the track girders for each bridge. The length of roll of the new bridge is about 10 ft. greater than that of the old design, and in addition to this, the bearings were set back about 4 ft. on the pier, thus making the rear support of the girder about 14 ft. back of that for which the piers

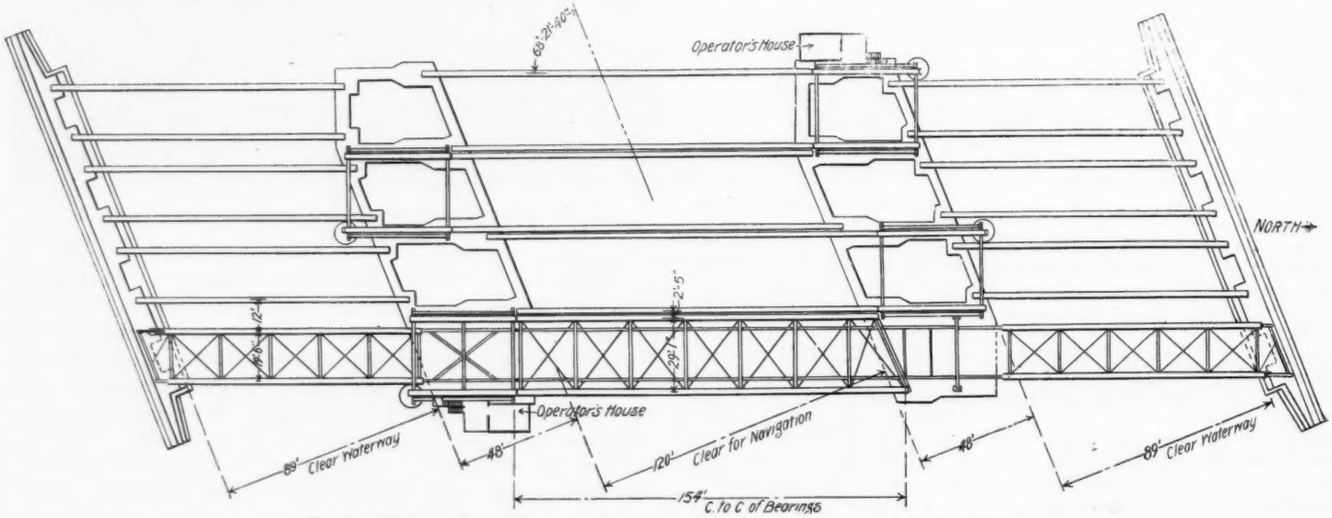
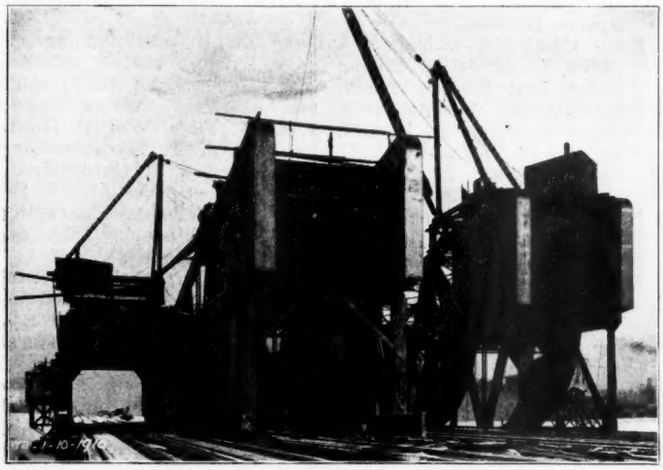


Fig. 3. Plan of Rolling Lift Bridge Over Sanitary and Ship Canal.

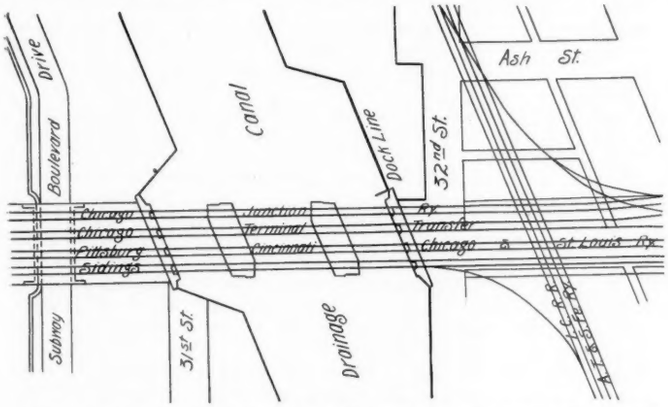
were designed. These cylinders are 9 ft. in diameter and were sunk to rock. They are made of a ½-in. steel shell filled with concrete, reinforced around its circumference by 1 ¼-in. square bars set vertically.

For in each truss the total rolling load is 852 tons, the track girder weighs 65 tons, the segmental girder 52 tons, and the structural steel 363 tons. The counter weight amounts to approximately 500 tons, which is made up of concrete, weighing 140 lbs. a cu. ft. in which pockets are provided for adding pig iron for the final adjustment of balance.



The Scherzer Rolling Lift Bridge.

The movements of the four bridges are to be controlled from two operator's houses, the two bridges supported on the south pier being operated from the south house, and the two on the north pier from the north house. Each leaf is operated by two, 50-h.-p. direct current motors from a series-parallel controller in the operator's house. The latch at the front of each leaf is operated by a 3 h.-p. motor. The control of each leaf is independently interlocked with the signals protecting the two tracks passing over it, so that



Layout of Scherzer Rolling Lift Bridge Over Sanitary and Ship Canal.

it is impossible for the operator to unlock the bridge until the signals have all been set. The operations of unlocking the bridge and of raising the leaf are also interlocked to prevent any attempt of the operator to raise the leaf before the bridge is unlocked. This interlocking is by contact switches operating in the closing circuits of the mill type contactors on the switchboard. Electric light indicators in both operator's houses show the positions of the bridge leaves and locks. Each motor is provided with a solenoid brake. Those on the end latches are automatically applied when the latch reaches the end of its stroke, and the current is automatically cut out from the motor at the same time. The operating machinery for each leaf is provided with an emergency brake in addition to the solenoid motor brake. The emergency brake is controlled by a motor-operated mechanism, which allows it to be applied instantly at the will of the operator, or automatically when the current is cut off.

In replacing the old spans with the new movable spans, traffic was diverted from two tracks at a time, the other six being always open for operation. It was 62 days after diversion of traffic from an old span before traffic could be turned back on to the new bridge.

Figs. 4 and 1 show the progress that had been made up to February, 1910, in the erection. Three of the spans are in place and the erection of the fourth is under way.

The contract for the fabrication and erection of the structural steel was taken by the Chicago Bridge & Iron Works, Chicago, the complete electrical equipment was sublet to George P. Nichols & Bro., Chicago, and the erection to the Ketler-Elliott Erection Co., Chicago. The design was made by the Scherzer Rolling Lift Bridge Co., Chicago, Albert H. Scherzer, president and chief engineer, with the co-operation of the engineers of the Sanitary District of Chicago, C. R. Dart, bridge engineer, S. T. Smetters, assistant bridge engineer, and F. R. Williamson, assistant engineer in charge of construction. Ralph Modjeski represented the railway companies as consulting engineer and the chief engineer of each company also approved all plans.

LIST OF EXHIBITS.

The following is a complete list of all exhibts in place or being installed in the Coliseum yesterday (Monday) afternoon. The completeness was a compliment to the committee in charge.

Adams & Westlake Company, Chicago.—Signal lamps, lanterns; railway specialties. Represented by W. H. Baldwin, G. L. Walters, H. G. Turney, A. S. Anderson, C. B. Carson, W. J. Pierson. Spaces 83 and 84.

Adreon Manufacturing Company, St. Louis.—Clark tension set tie plate, Security rail brace and tie plate. Represented by E. L. Adreon, Jr. and Wm. Miller. Space 109.

Advance Power Company, Chicago. Inspection car. Represented by Mr. Warner. Space 215.

Alamo Manufacturing Company, Hillsdale, Mich.—Gasolene, gas, kerosene and distillate engines for railway service, pumping outfits, charging storage battery plants. Represented by L. A. Hopkins, J. L. Benedict, B. L. Winchell, Jr., R. A. Paterson, H. F. Worden, L. C. Thompson. Space 99.

Alexander Crossing Company, Clinton, Ill.—Continuous-rail, non-pounding crossings. Represented by M. J. Hinchcliff, C. R. Wescott, I. N. Brown. Spaces 204-5-8-9.

Allith Manufacturing Company, Chicago.—Approved fire-door; warehouse door; continuous parallel door; merchandise carrier. Represented by W. D. Jameson, W. C. Lang. Space 116.

American Concrete Company, Chicago.—Reinforced concrete pipe, piling and girders. Represented by O. J. West, G. H. Scribner, Jr., O. P. Scribner, D. S. Edwards. Space 15.

American Guard Rail Fastener Company, Philadelphia.—Anchor guard rail clamps, tie plate guard rail fasteners, Vaughan automatic rail anchors. Represented by D. F. Vaughan, Chas. Z. Vaughan. Space 118.

American Hoist & Derrick Company, St. Paul, Minn.—Moving pictures, "American" railway ditcher, hoisting engines, etc. Represented by Frank J. Johnson, W. L. Manson, W. O. Washburn. Spaces 189, 190 and 191.

American Locomotive Company and Atlantic Equipment Company, New York and Chicago.—Photographs, catalogues and pamphlets of steam shovels, locomotives, dredges, rotary snow plows and automobiles. Represented by John H. Wynne, Ottis Parsons, Edwin M. Hall, A. M. Sheffer. Space 30.

American Rail Joint Company, Toronto, Canada.—Reinforced angle bars. Represented by Tho. D. Beddoe. Space 194.

American Railway Device Company, Chicago.—Track specialties, tool grinder attachment for handcars, anti-rail

creepers, Economy separable switch points. Represented by O. Metcalf, Jr. Space 177.

American Railway Signal Company, Cleveland, Ohio.—Electric Automatic signals; electric switch locks; electric dwarf signals; lower and switch indicators; relays and electric interlocking apparatus. Represented by G. L. Weiss, H. M. Abernethy, H. D. Abernethy, J. L. Burrows. Spaces 22 and 23.

American Railway Steel Tie Company, Harrisburg, Pa.—Combination steel and asphalt ties. Represented by John G. Snyder.

American Steel & Wire Company, Chicago.—Right-of-way fencing, rail bonds, triangle mesh concrete reinforcement, nails and wire, electrical wires, W. & M. telephone wire. Represented by B. H. Rider, H. S. Durant, R. C. Moeller, C. S. Knight, J. M. Holloway, L. P. Shanahan, H. A. Parks. Spaces 69-70 and 50-51.

American Valve & Meter Company, Cincinnati, Ohio.—Water service supplies, embracing Poage improved automatic water columns; tank valves and fixtures; float valves; Fenner drop spout; track devices showing the Economy switch stands; Anderson's safety switch lock. Represented by J. T. McGarry, F. C. Anderson, Burton W. Mudge. Spaces 130 and 131.

American Vulcanized Fibre Company, Wilmington, Del.—Vulcanized fibre for rail joint insulation. Represented by John Barron.

American Well Works, Chicago.—Deep well and centrifugal pumping machinery, with any style of power, air compressors, well drilling and prospecting machinery. Represented by Geo. W. Igo, C. O. McLean, A. W. McLean. Spaces 12 and 13.

Cortlandt F. Ames, Chicago.—Hercules bumping posts, manufactured by J. M. Scott & Sons, Racine, Wis.; Automatic lock nuts, manufactured by Automatic Lock Nut Company, Rockford, Ill. Represented by J. M. Scott, E. E. Scott, Chas. Rystrom, Cortlandt F. Ames. Space 115.

Armspear Manufacturing Company, New York.—Pressed steel switch lamps, one-day and long-time burners; semaphore and train order lamps; automatic classification and train markers; steel and wire guard lanterns. Represented by F. D. Spear, C. K. Freeman, F. A. Buckley. Space 184.

Asphalt Ready Roofing Company, New York.—Roofing materials, asphalt saturated felts. Represented by Birney Blackwell, C. A. Sparrowhawk, J. A. Sturges, H. D. Keeler. Space 168.

Atlas Portland Cement Company, New York.—Samples of Portland cement. Represented by P. Austen Tomes, D. H. MacFarland, E. D. Boyer, John Evans. Space 146.

Badger Brass Manufacturing Company, Kenosha, Wis.—Locomotive and interlocking headlights. Represented by W. A. Belle, R. H. Welles, W. L. Yule. Space 220.

Barker Mail Crane Co., Clinton, Ia.—Mail crane. Represented by L. W. Barker. Space 181.

Barrett Manufacturing Company, New York.—Roofing; bridge waterproofing with bituminous binder protection; floor construction particularly adapted for repair shops and freight houses. Represented by W. S. Babcock, L. P. Sibley, H. B. Nichols, C. T. Bilyea, W. J. Walker. Space 106.

Bausch & Lomb Optical Company, Rochester, N. Y.—Engineering and surveying instruments, transits, levels, etc. Represented by W. Louis Johnson, F. M. Storr, H. D. Skelton. Space 17.

Beaver Dam Malleable Iron Company, Beaver Dam, Wis.—Tie plates and rail braces. Represented by Lawrence Fitch, J. V. Cowling, F. S. McNamara, E. A. Hawks, W. L. Douglas, D. P. Lamoreux, A. E. Martin, E. M. Cowling. Space 166.

Bird, F. W., & Son, East Walpole, Mass.—Pariod roofing, building papers and waterproofing, roof paints, etc. Represented by A. R. McAlpine, W. E. O'Neill, M. L. Caton, C. H. Martin. Space 2.

Bird, J. A. & W., & Co., Chicago.—Rex Plinkote roofing, signal railroad roofing, Concrex roofing, Zolium tile roofing, Paradux canvas top roofing, Tunaloid waterproofing felt, insulating papers, roof and damp proof paints, Ripolin enamel paint. Represented by F. E. Cooper, H. W. Benedict, F. A. Dale, M. B. Hood, Howard Schofield, Paul L. Griffiths, C. E. Rahr. Space 140.

Blocki-Brennan Refining Co., Chicago.—Carboxide, elastic metal preserver. Represented by W. F. Brennan, J. A. Early. Space 169.

Bossert, W. E., Manufacturing Company, Utica, N. Y.—Triple-lock switch stand, Bossert insulated rail joint, Bossert improved switch point adjuster, tie plate and guard rail clamp, semaphore blade clasps, Reliance spike braces. Represented by F. L. Guillaume, H. C. Williams, Willis C. Squire, F. G. Squire. Space 137.

Bowser, S. F., & Co., Inc., Fort Wayne, Ind.—Oil storage systems, Bowser self-measuring pumps. Represented by C. A. Dunkleberg, W. T. Simpson. Space 16.

Bryant Zinc Company, Chicago.—Signal supplies, battery supplies, fiber conduit, storage batteries, crossing bells, battery vaults and chutes, electrical instruments, track and linemen's tools. Represented by E. M. Deems, R. N. Baker, Stanley Bryant, H. J. Hovey, A. F. Klink, R. N. Chamberlain, R. Parmelee, P. W. Herbst, J. W. Cremerius. Spaces 153-4-5-6.

Buda Company, Chicago.—Railway motor cars and velocipedes, track drills, drill grinders, switch stands, ratchet jacks, ball bearing jacks, adjustable switch rods, solid manganese crossing, replacers, electric crossing gates. Represented by H. K. Gilbert, L. M. Viles, Wm. P. Hunt, Jr., C. H. DeLano, W. B. Paulson, J. T. Harahan, Jr., Geo. B. Shaw, L. Hamill, A. R. Dyer, J. J. Gard, H. S. Evans, W. T. Smettem, W. E. Marvel. Spaces 87-88-89-90.

Buff & Buff Manufacturing Company, Chicago.—Surveying instruments. Represented by The Engineering Agency, A. G. Frost, D. E. Rossetter. Half of space 94.

Buyers' Index Company, Chicago.—Book "Purchasing Agents, Buying List and Railway Supply Index." Represented by Lloyd Simonson, D. J. Beaton, F. B. Cozzens. Space 112.

Card & McArdle, Waukegan, Ill.—Timber-treating engineers. Represented by J. B. Card. Space 221.

Philip Carey Company, Cincinnati, Ohio.—Roofing, asbestos and magnesia products, insulating materials. Represented by R. B. Murdock, E. S. Main, C. L. Cockrell. Space 170.

Carnegie Steel Company, Pittsburg.—Section of railroad track, constructed with steel crossties, Duequesne joints and 100-lb. American Society rail, with various types of fastenings, including wedge fastenings illustrated in Bulletin No. 108. General assortment of Duquesne rail joints for principal sections of standard rails; Schoen steel wheels, including a wheel having been worn in service representing 301,374 miles; nickel-plated samples, showing various types of U. S. and Friestedt sheet piling. Represented by N. M. Hench, Edwin S. Mills, C. B. Friday, D. B. Coey, W. A. Bostwick, P. W. O'Brien, H. C. Griswold, Robt. Coe, A. R. Archer. Spaces 71-72-52-53.

Central Electric Company, Chicago.—General western agents for the Okonite Company, New York.—Okonite wires, aerial, lead covered and submarine cables, pot heads, joints, Manson and Okonite tapes, and samples of crude rubber. Represented by J. N. Lorenz, M. Cox, W. D. Dunsmore, D. M. Ayers, Lewis D. Martin, F. J. White. Spaces 203 and 210.

Channon, H., Company, Chicago.—Shovels, pumps, blocks, wheelbarrows and other railway supplies. Represented by O. W. Youngquist, Harry Keegan, B. Berntsen. Space 160.

Chicago Steel Tape Company, Chicago.—Steel tapes, leveling rods, lining poles, etc., for field use. Represented by L. A. Nichols, J. Levinson. Half of space 94.

Chicago Tie & Rail Fastening Company, Chicago.—Rail fastenings, tie plates and concrete ties. Represented by Andrew Stark, Henry Bryant, Burt F. Fuller. Space 174.

Cleveland Frog and Crossing Company, Cleveland.—"Hard Service" manganese frogs and crossings, improved spring rail frogs, switches, switch stands, guard rail clamps, Prentice anti-rail creepers, etc. Represented by G. C. Lucas, George Stanton, George A. Peabody, L. G. Parker, George Arnold, Jr. Spaces 102-3-4.

Iszard-Warren Company, Inc., Philadelphia.—"Sterling" transits and levels, engineering and drawing materials. Represented by J. Henry Warren.

Clow, James B., & Sons, Chicago.—Plumbing, steam, water and foundry products. Represented by W. E. Clow, Jr., Yates A. Adams, W. T. Brace, J. L. Ponic, W. R. Plum, L. J. Elliott. Space 33.

Conley Frog & Switch Company, Memphis, Tenn.—Conley patent frog, manganese frogs, rail braces, railway track appliances. Represented by John E. Conley, Fred C. Taylor. Space 34.

Cook Standard Tool Company, Kalmazoo, Mich.—Jacks, track drills, drill grinders, bits. Represented by E. Cook, E. H. Edelmann. Space 183.

Coulter-Paxton Company, Hammond, Ind.—Track wrench, rail drill and bonding rail drill. Represented by W. G. Paxton, J. W. Paxton, C. J. Coulter. Space 172.

Crear, Adams & Co., Chicago.—Hercules steel warehouse trucks for handling portable articles, such as freight packages, barrels, boxes, etc. Represented by C. A. Roberts,

F. R. Sheperd, P. J. Ford, Russell Wallace, J. A. Martin, C. W. Gregory, T. W. Bartlett, G. D. Bassett, G. B. Howard, R. M. Bullard. Space 95-96.

Detroit Graphite Company, Detroit, Mich.—Paint for bridges, buildings, structural steel, etc. Represented by T. R. Wyles, L. D. Mitchell, Edwin Booth, A. H. Kuerst. Space 167.

Detroit Hoist & Machine Company, Detroit.—Pneumatic and electric locomotive turn-table tractors. Represented by J. C. Fleming, F. B. Fleming. Space 191.

Paul Dickinson, Inc., Chicago.—Smoke jacks, cast iron chimneys and ventilators. Represented by J. A. Meaden, A. J. Filkins, E. W. Hodgkins, W. H. Dayton, Geo. M. Kenyon, F. C. Webb, F. W. Brydges. Space 186.

Eugene Dietzgen Company, Chicago.—A complete line of surveying instruments, leveling rods, ranging poles, tapes, rail profile machines, and other supplies which are used by engineers and surveyors both in the office and in the field. Represented by W. E. Cook, W. O. Phillips, O. S. Rhea. Space 97.

Dilworth, Porter & Co., Limited, Pittsburg.—Railroad spikes, tie plates. Represented by W. F. Schleiter. Space 26.

Joseph Dixon Crucible Company, Jersey City, N. J.—Graphite paint, lubricating graphite, crucibles and plumbago. Represented by E. R. Smith, B. B. Worley, H. W. Chase. Space 117.

Dressel Railway Lamp Works, New York.—Switch lamps, semaphore lamps, tower lamps, station lamps, engine lamps, tail marker lamps, caboose lamps, crossing gate lamps. Represented by Robert Black, E. W. Hodgkins, F. W. Edmunds, A. P. Grenier, W. H. Dayton. Space 5.

G. Drouve Company, Bridgeport, Conn.—Anti-Pluvius puttyless skylights and sash operators, "Lovell" and "Straight Push." Represented by William V. Dee, George J. Adams, R. S. Adam, A. H. Bates. Space 158.

Duntley Manufacturing Company, Chicago.—Rockford gasoline section and inspection cars, Rockford track weeder, Duntley pneumatic cleaners. Represented by L. C. Thompson, H. F. Worden, J. G. Minert, E. J. Cornish, R. A. Patterson, B. L. Winchell, Jr., Geo. M. Kenyon. Spaces 81 and 100.

Duplex Metals Company, New York.—Copper clad steel wire, model of coating process and material in various stages of manufacture; samples of all kinds. Represented by Frank R. Chambers, Jr., James F. Kinder, Wirt Tassin, George Wolf, W. T. Kyle, Geo. B. Muldaur, Jas. A. Waugh. Spaces 38 and 39.

Eastern Granite Roofing Company, New York.—Granite roofing, Evertite crushed stone roofing, Tisbest smooth surface roofing. Represented by H. Henning, P. G. Kennett, A. W. Turner, C. F. Barstow. Space 129.

Economy Separable Switch Point Company, Inc., Louisville, Ky.—"Mitchell" and "Palmer" types separable switch points; Economy separable claw bars. Represented by W. M. Mitchell, W. M. Mitchell, Jr., B. B. Betts. Space 187.

Edison Manufacturing Company, Orange, N. J., and Chicago.—B. S. C. O. and Edison primary batteries for signal work, automatic block signals, crossing bells. Represented by E. E. Hudson, F. J. Lepreau, E. W. Brown. Space 151.

O. M. Edwards Company, Syracuse, N. Y.—Railroad padlocks and railway devices. Represented by C. H. Rockwell, Russell Hotchkiss. Space 150.

Electric Storage Battery Company, Philadelphia.—"Chloride Accumulator" batteries for drawbridge operation and "Chloride," "Tudor" and "Exide" types for car lighting, signal, interlocking and automatic block signal work. ET. couple types for small lighting plants and telegraph service. Represented by G. H. Atkin, T. Milton, R. I. Baird, T. A. Cressey. Space 149.

Fairbanks, Morse & Co., Chicago.—Motor cars, standpipes, pumping machinery, dynamos, drills, scales, etc. Represented by A. A. Taylor, C. W. Kelley, R. E. Derby, L. H. Matthews, F. M. Condit, F. H. Clark, C. D. Walworth, R. D. Head, F. F. French, F. E. Church, H. C. McClary, S. F. Forbes, J. G. Jones, J. A. Steele, E. M. Fisher, L. Norvell, F. B. Roy, A. F. Young, H. D. Smith, A. C. Dodge, F. H. Douglas. Spaces 35-6-7 and 54-5-6.

Federal Signal Company, Albany, N. Y.—Electrical and mechanical signaling and interlocking apparatus. Represented by J. T. Cade, A. Dean, Jr., H. H. Cade, W. H. Reichard. Space 93.

Ford & Johnson Company, Chicago.—Line of Perfection railroad seats and chairs for parlor and buffet cars. Also rattan seating. Represented by Benjamin H. Forsyth, Walter J. Bennet, Clarance A. Van Derveer. Space 159.

Frank M. Foster, Columbus, Ohio.—Foster interlocking switch stands with independent facing point lock and distant signal operated with one movement of one lever. Represented by Frank M. Foster, George E. Kalb. Space 138.

Franklin Manufacturing Company of Pennsylvania, Franklin, Pa.—Asbestos reinforced corrugated roofing or siding, asbestos "Century" shingles, asbestos building lumber and asbestos lumber smoke jacks, asbestos pipe coverings, Chapman circular glass cutter. Represented by R. J. Evans, E. R. Rayburn, L. B. Melville, F. S. McNamara, John G. Sanborn. Space 6.

Thomas A. Galt, Sterling, Ill.—Steel-cushioned railroad tie. Represented by J. W. Hatch, E. W. Aument, E. L. Galt, Thomas A. Galt. Space 224.

General Railway Signal Company, Rochester. N. Y.—All electric interlocking machines, electric switch movements, various types of power signals, automatic signals, manual control signals, relays and other such devices. Represented by W. W. Salmon, L. Thomas, W. K. Howe, Geo. D. Morgan, F. L. Dodgeson, M. R. Briney, J. L. Langdon, H. M. Sperry, M. Wuerple, C. O. Poor, J. B. Evans, G. H. Macdonough, W. R. Young, F. H. Jones. Spaces 57-8-9-60.

Goheen Manufacturing Company, Canton, Ohio.—Preservative coatings for iron and steel. Represented by A. W. Price, G. L. Clapper. Space 109.

Peter Gray & Sons, Inc., Boston.—Railroad lamps and lanterns. Represented by Geo. M. Gray, J. M. Brown. Space 175.

Greenlee Bros. & Co., Chicago.—Railway tie boring, plugging and facing machines (Kendrick patents), screw spike driving machines. Represented by J. A. Lounsbury, O. V. Haegg. Space 7 and 8.

Grip Nut Company, Chicago.—Grip nuts, special grip holding nuts. Represented by E. R. Hibbard, Herbert Green, B. L. McClellan, W. G. Wilcoxson, B. C. Wilt, R. A. Flum, B. J. Bernhard, J. W. Hibbard. Space 40 and 41.

Hall Signal Company, New York.—Railway signals and accessories. Represented by W. J. Gillingham, Jr., W. H. Lane, W. G. Hovey, H. L. Hollister. Space 80.

Handlan-Buck Manufacturing Company, St. Louis.—Lamps, lanterns, long-time burners, Cairncross train indicators, track tools, McPartland rail clutches, metallic slow flags, and metallic train flags. Represented by A. H. Handlan, Jr., R. L. Cairncross, E. W. Handlan. Space 125.

Hart Steel Company, Elyria, Ohio.—Railroad tie plates and standard spikes. Represented by W. S. Miller, W. T. Bentz, Willis McKee, G. S. Wood, A. W. DeRocher, H. W. Davis, J. M. Van Harlingen. Space 101.

Hayes Track Appliance Company, Geneva, N. Y.—Hayes derails and attachments. Represented by S. W. Hayes, W. Harding Davis, Wellington B. Lee, Arthur Gemunder, K. M. Thompson, S. W. Wallace. Space 139.

Heath & Milligan Manufacturing Company, Chicago.—Siding finished with Way & Station paint and panels decorated with Durotone, a new and unique paint which dries absolutely flat, with a velvet-like, soft finish, which is sanitary and waterproof, and at the same time possesses unusual wearing qualities. Also a brineproof paint and rust inhibitive; paints and finishes for all seam and electric railway painting purposes. Represented by A. M. Heath, B. H. Pinkerton, J. H. Vance, C. R. Arnold, J. B. Campbell. Space 179.

Hobart-Allfree Company, The, Chicago.—Smyth and Freeland derailers; Newton car replacers. Represented by E. H. Allfree, W. H. England, Frank P. Smith. Space 148.

Hoskins Rail Chair Company, Chicago.—The Hoskins Combined Rail Joint and Chair. Represented by Zachary T. Hoskins, N. L. Towle. Space, half of 198.

James O. Heyworth, Chicago.—Three-yard bucket of the Heyworth-Newman excavator. Represented by H. N. Elmer, R. A. Meredith.

Interlocking Nut & Bolt Company, Pittsburg.—The Clark nut lock, as applied to track bolts; frog and crossing bolts; steel tie bolts, bolts for interlocking work, track bolts for cars. Represented by R. A. Clark. Space 185.

H. W. Johns-Manville Company, New York.—Asbestos and magnesia materials, electrical supplies, roofings, smoke jacks. Represented by J. E. Meek, J. C. Younglove, F. M. Gilmore, C. E. Murphy, H. A. Waldron, J. M. Trent, P. C. Jacobs, G. W. Risteen, Jr., R. A. Hamaker, H. G. Newman, H. T. Morris. Space 144.

O. F. Jordan Company, Chicago.—The Jordan earth and ballast spreader and snow plow combined. Represented by M. J. Woodhull. Space 181.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.—Manufacturers of hand, push and velocipede cars, improved track drills, jacks, pressed steel wheels, crossing

gates and other track appliances. Represented by John McKinnon, Chas. B. Hays, Frank B. Lay, C. A. Wallace, Donald A. Stewart, Geo. W. Mingus, W. I. Clock, H. C. Wilson. Spaces 24 and 25.

Joyce-Cridland Company, Dayton, Ohio.—Hydraulic and all other types of jacks. Represented by F. I. Joyce, George W. Llewellyn, N. Kohl, C. F. Palmer, Edwin Romeiser. Space 77.

W. K. Kenly Company, Chicago.—Security anchor tie plate, Gump car replacer, Latimer switch point lock, Universal carrier base, Arctic water box, Manhatton compromise joint, Moore trick drills, Kalamazoo velocipedes. Represented by A. P. Van Schaick, W. J. Fauth, Gerard Van Schaick. Spaces 78-79.

Kennicott Water Softener Company, Chicago Heights, Ill.—Water softening machinery. Represented by Cass L. Kennicott, Edwin J. Flemming, Frank S. Dunham, T. J. Windes. Space 74.

Kerlin Automatic Post Machine Company, Delphi, Ind.—Cement post machine; reinforcement for concrete post and concrete railroad tie. Represented by Wm. F. Kerlin, E. W. Bowen, E. R. Smock, Rega Porter, Wm. Donlin, R. C. O'Connor, W. A. Eldridge, Roy Kennedy, S. Benefield. Spaces 211-212-213.

Kerite Insulated Wire & Cable Company, New York.—Kerite insulated wires and cables. Represented by Azel Ames, P. W. Miller, J. V. Watson, B. L. Winchell, Jr., R. A. Paterson, E. B. Price, J. A. Renton. Spaces 61 and 62.

Keystone Driller Company, Chicago.—One large size double-stroke geared pump head for deep wells; plungers, working barrel, one model double-stroke geared pump in operation; also catalogue of deep well drilling machinery. Represented by E. O. Eyer, R. M. Downie. Space 188.

Kueffel & Esser Company of New York and Chicago.—Drawing materials, surveying instruments, drawing instruments, measuring tapes, etc. Represented by Rudolph Link, G. C. Moore. Space 98.

Lackawanna Steel Company, New York.—Rails, rail joints, structural and bridge material, reinforced concrete bars, steel sheet piling and track supplies. Represented by C. R. Robinson, G. A. Hagar, C. H. Hobbs, Blythe Harper. Spaces 31 and 32.

Lehon Company, Chicago.—Roofings, waterproofings and paints; manufacturers Roofite roofing with over-seal lap; Roofite car and cab roofing; Roofite waterproofed canvas for passenger cars; Roofite sill covering; mule-hide rubber roofing; Dry-Art insulating paper; Polar-Bear insulating paper; Lehon's duplex refrigerator felt; Niagara waterproof paper; Roofine paint; Damptite waterproofing compound. Represented by Tom Lehon, John T. Sullivan, C. E. Rice. Space 220.

Lidgerwood Mfg. Co., Chicago.—Incline car hoist. Represented by Frank D. Knight, W. G. Wilmot. Space 196.

Link-Belt Co., Chicago.—Elevating and conveying specialties as applied to the handling of coal, freight, etc., by railways; photographs, printed matter, etc. Represented by J. C. Nelligar, W. W. Sayers, R. C. Turner. Space 128.

Lufkin Rule Company, Saginaw, Mich.—Measuring tapes of all descriptions; steel rules, etc. Represented by Theo. Huss, S. B. McGee, B. F. Gould, F. G. Brown. Space 121.

Lutz-Lockwood Manufacturing Co., Aldene, Union Co., N. J.—Lutz primary cells (disc type), Gordon primary cells and "SX" ignition dry cells. Represented by W. M. Kinch, Geo. Marloff. Space 133.

David Lupton's Sons Company, Philadelphia.—Lupton steel sash; Lupton rolled steel skylight; Pond operating device; Pond continuous sash. Represented by Clarke P. Pond, George P. Heinz. Space 92.

Mackenzie-Klink Publishing Co., Chicago.—The Signal Engineer; The Signal Directory; Railway Electrical Engineer; Modern Machinery. Represented by L. B. Mackenzie, A. F. Klink, A. D. Cloud, Edward Wray, Edward Hammond, J. P. Sharpe, C. E. Gould, Fred W. Bender. Space 136.

Indianapolis Switch & Frog Company, Springfield, Ohio.—Manganese frogs, crossings, switches, etc. A special showing of I. Sw. & F. Co. Model R-N-R manganese frogs and tests. Represented by E. C. Price, W. H. Thomas, W. L. Walker, T. D. Hanley, G. S. Shaw, J. A. Foulks. Space 182.

Manganese Steel Rail Company, New York.—Manganese steel products consisting rails, sheets, plates and forgings. Represented by F. W. Snow, Sumner T. McCall, Oakley W. Cooke, E. Payson Cooke, W. S. Potter, F. C. Stowell, J. R. Aigeltinger.

Mann McCann Co., Chicago.—Graders, spreaders, snow plows, smoke jacks, track movers, flue rattlers, ventilators, etc.; The Mann No. 3 Universal machine. Represented by O. C. Mann, L. C. Mann. Space 176.

C. F. Massey Company, Chicago.—Railway signal materials. Massey battery wells. Represented by C. F. Massey, Wm. H. Powell, R. J. Collins, E. J. Relph Space 134.

W. N. Matthews & Brother, St. Louis.—Matthews guy anchors, telephone jack boxes and plugs for dispatching systems, cable clamps, cable splicing joints, lamp guards, and other money saving specialties. Represented by Clause L. Matthews, W. N. Matthews, Victor L. Crawford, Walter E. Bichoff. Space 142.

Alexander Milburn Co., Baltimore, Md.—Portable lights. Represented by A. F. Jenkins, Benj. Surjcek. Space 216 Annex.

Miracle Pressed Stone Company, Minneapolis, Minn.—Collapsible steel forms for concrete culvert and sewer construction. Represented by O. U. Miracle. Space 14.

Morden Frog & Crossing Works, Chicago.—Unity switch stand operating distant signal and facing point switch with positive point lock. Parallel ground throw, G. L. M. switch stand, rigid manganese steel frogs; guard rail clamps; switch adjustments; rail braces; slide plates; track jacks; compromise joints, etc. Represented by Arthur C. Smith, H. M. Macke, D. H. Cusic, W. J. Morden. Space 86.

Morgan Frog & Crossing Co., St. Louis.—Continuous rail boltless frog. Represented by B. J. Morgan, G. H. Kelley. Space 192. Annex.

Burton W. Mudge & Company, Chicago.—Adams motor car, safety mail crane. Represented by Burton W. Mudge, C. M. Mudge, Geo. E. Simmons, Otto P. Hennig, W. E. Adams. Spaces 113-114.

Municipal Engineering & Contracting Co., Chicago.—Chicago improved cube concrete mixer. Represented by C. E. Bathrick. Space 19.

National Electric Specialty Company, Toledo, O.—Space 223. Annex.

National Lock Washer Company, Newark, N. J.—Nut locks. Represented by F. [illegible]. Archibald, G. E. Bake, F. B. Buss, John B. Seymour. Space 124.

National Malleable Castings Company, Cleveland.—Malleable track specialties. Represented by F. R. Angell, H. I. Hiatt, J. J. Byers. Space 145.

National Roofing Co., Tonawanda, N. Y.—Mineral asphalt roofing; gravel and feldspar surfaced; asphalt roof coating; asphalt paints; graphite paints; stack paint and metal protecting paints. Represented by O. H. Dean, A. E. Arbuckle, D. A. Bonitz, H. R. Sinnett. Space 195.

Geo. P. Nichols & Bro., Chicago.—Electric turntable tractor and drawbridge specialties; also photographs of transfer tables, turntable tractors and drawbridge installations. Represented by Geo. P. Nichols, S. F. Nichols. Space 173.

O. K. Nut Lock Co., Providence, R. I.—Bolts of all kinds equipped with O. K. Nut Lock. Represented by John R. Armstrong. Space 222, Annex.

Ohio Post Mold Company, Toledo, Ohio.—One six-post machine, two six-post machines designed for steam curing kilns. Several posts. Represented by E. S. Smith, A. M. Smith. Space 201.

Okonite Company, New York.—Central Electric Co., Chicago, general western agents: Okonite wires, aerial, lead covered and submarine cables, pot heads, joints, Manson and Okonite tapes and samples of crude rubber. Represented by Lewis G. Martin, F. J. White, J. M. Lorenz, M. Cox, W. D. Dunsmore, D. M. Ayers. Spaces, 203-210.

Spencer Otis Company, Chicago.—Economy railway tie plates. Represented by W. L. DeRemer, H. H. Hart, Carter Blatchford. Spaces, 122 and 141.

Otto Gas Engine Works, Chicago.—Coal chute machinery and spouts, guard rail clamp, gasoline engines. Represented by T. W. Snow, R. E. Gurley, H. C. Harnish, C. C. Lazenby, R. A. Ogle. Spaces 49 and 68.

Pacific Timber Preservative Company, Spokane, Wash.—Treated cross-ties, telephone and telegraph poles and fence posts. Comparison of results in actual track service. Represented by Robert E. Allen. Space 11.

W. W. Patterson Company, Pittsburg.—Double extra heavy wood tackle blocks for manila rope; double extra heavy steel tackle blocks for wire cable. Represented by W. W. Patterson, Jr. Space 147.

C. F. Pease Co., Chicago.—Automatic blue and white print machinery and engineering and drafting room supplies, consisting of automatic equipments for printing, washing and drying both blue prints and direct white prints by one continuous operation; also trimming tables and other blue print apparatus, as well as a full line of Sterling engineering transits, levels, etc. Represented by C. F. Pease, P. M. Morgan. Spaces 161 to 164, inclusive.

Pennsylvania Steel Company, Steelton, Pa., and Maryland Steel Company, Sparrows Point., Md.—Solid Manard crossing, No. 40; Manard anvil face frog, design 160, section No. 235; No. 10 solid Manard frog, section No. 235; No. 10 spring rail frog, design 278, section No. 235; sample Never-

Turn split bolt; Never-Slip slide plate; New Process switch with rolled Manard (improved manganese) stock rail; intermediate main line safety switch stand, Model 56-B; low New Century switch stand, Model 51-A; low Steelton positive switch stand, Model 52-A; intermediate New Century switch stand, Model 50-E, with semaphore attachment; rolled Manard (improved manganese) rails; solid cast Manard frogs. Represented by C. W. Reinoehl, B. L. Weaver, G. S. Vickery, Wm. M. Henderson, N. E. Salsich, Robert E. Kelknap, H. F. Martin, J. C. Jay, Jr., C. S. Clark, R. M. Lechthaler, Drew Allen, W. H. Allen, M. L. Long, H. G. Barbee, J. W. Hennessey, C. F. Rolland. Spaces 45-6-7-8 and 64-5-6-7.

Pittsburg Steel Company, Pittsburg.—"Pittsburg Perfect" fencing for railroad right-of-way. Represented by W. R. Marsh, E. D. Finlay, E. Steytler. Space 197.

Pocket List of Railroad Officials, New York.—Pocket List of Railroad Officials. Represented by J. Alexander Brown, Chas. L. Dinsmore. Space 26.

D. & A. Post Mold Co., Three Rivers, Mich.—"D. & A." concrete post machinery and molds; specimens of reinforced cement posts; also sections of same showing construction, materials used; also different methods of reinforcement, as applied to the farm, vineyard and railway use. Represented by G. H. Dougherty, L. R. Dougherty, O. Dougherty. Space 132.

Potter-Winslow Company, Chicago.—Reinforced concrete battery vaults, concrete battery chutes, storage battery containers, concrete foundations, concrete posts and signs. Represented by Frank H. T. Potter, A. C. Heidelberg, W. R. Potter. Space 185.

Q. & C. Company, New York.—Bonanzo joints; step joints, insulated joints, anti-rail creepers, rail saws, rail benders, guard rail clamps, guard rail braces, rail braces, castings, bolts and nuts, cement and metal ties. Represented by C. F. Quincy, G. C. Isbester, Geo. L. Hall, T. B. Bowman, J. V. Wescott, J. A. Bodkin. Spaces 119-120.

Rail Joint Company, New York.—Continuous Wever and Wolhaupter types, base supporting rail joints. Represented by V. C. Armstrong, L. F. Braine, W. E. Clark, J. A. Greer, Percy Holbrook, H. C. Holloway, J. G. Miller, F. A. Poor, E. L. Vandresar, B. Wolhaupter, F. C. Webb, E. A. Condit, Jr., S. J. Collins. Space 82.

Railroad Fence Works, Chicago.—Railroad fencing. Represented by E. G. Fisher. Space 165.

Railroad Supply Company, Chicago.—Tie plates, derailers, signals. Represented by E. H. Bell, C. P. Cogswell, Jr., M. J. Comerford, E. W. Vogel, A. H. Smith, G. W. Daves, H. M. Bulk, W. H. Dayton, Frank C. Webb. Space 85.

Railway and Engineering Review, Chicago.—Represented by Willard A. Smith, Walter M. Camp, Clyde F. Burns, J. M. Lammedee, Paul R. Brooks, A. E. Hooven, G. E. Ryder, P. G. Stevens, Harold A. Smith. Space 20.

Railway Age Gazette, Chicago.—Railway Age Gazette, Daily Railway Age Gazette and standard railway publictions. Represented by Edward A. Simmons, Ray Morris, Samuel O. Dunn, Lucius B. Sherman, John N. Reynolds, Frank S. Dinsmore, Cecil R. Mills, Bradford Boardman, William Forsyth, George L. Fowler, Francis E. Lister, H. H. Simmons, Henry Lee, William E. Hooper, Francis W. Lane, S. H. Ankeney, W. H. Arkenburgh, T. E. Crossman. Spaces 44 and 63.

Railway List Co., Chicago.—The Monthly Official Railway List, Railway Master Mechanic, Railway Engineering and Maintenance of Way. Represented by Wm. E. Magraw, C. S. Myers, C. C. Zimmerman, G. Miller, L. F. Wilson, N. F. Rehm, O. N. Middleton. Space 112.

Railway Specialty & Supply Co., Chicago.—P. & M. rail anchors, arc damp lightning arresters; photographs showing effect of rail creeping, signal accessories. Represented by Philip W. Moore, L. W. Kent, A. G. Rockwell, F. A. Preston. Space 105.

Rampo Iron Works, Hillburn, N. Y.—Automatic safety switch stands; manganese pointed switches; manganese center frogs, rolled manganese steel rail, etc. Represented by F. W. Snow, Arthur Gemunder, W. B. Lee, W. C. Kidd, F. C. Stowell, Jas. B. Strong. Spaces 91 and 110.

Roberts & Schaefer Co., Chicago.—Working model of Holmen-Barrett coaling station, working model of Sauerman Siamese coal breaker, and enlargements of photographs of various types of coaling stations. Represented by Edward E. Barrett, Clyde P. Ross, Hiram F. Post, James S. Shannon. Space 73.

St. Louis Steel Foundry, St. Louis.—Solid manganese steel frogs, crossing and inserts for steam and electric railways. Represented by J. H. Steedman, J. N. Maher. Space 3 and 4.

Scherzer Rolling Lift Bridge Company, Chicago.—Models, photographs, designs, plans, drawings, and literature. Represented by A. H. Scherzer, C. L. Keller, J. I. Vincent, J. T. Dickerson, W. F. Martin, H. D. Harting, R. W. Flowers. Space 178

Sellers Manufacturing Company, Chicago.—Tie plates, angle bars, "Sellers Anchor Bottom Tie Plate." Represented by J .M. Sellers J. T. Markman, L. S. Gordon. Space 123.

Standard Asphalt & Rubber Co., Chicago.—Sarco products and Sarco methods for water proofiing concrete surfaces. Represented by W. H. Lawrence, R. E. Kartack. Space 1.

Strauss Bascule & Concrete Bridge Company, Chicago.—Drawings and models of Strauss trunnion bascule bridges. Space 157.

Strauss Self-Balancing Window Company, Chicago.—Drawings and models of Strauss self-balancing windows for buildings, cars, vessels, etc. Space 157.

Strobel Steel Construction Company, Chicago.—Models of bascule bridges, photographs of bridges, center of locomotive turntables. Represented by Theodore Rall, J. C. Holland, E. Haupt. Space 180.

Streeter-Amet Weighing & Recording Company, Chicago.—Automatic weight recording machine for railroad track scales for weighing carload shipmentts, and automatic quick weighing dial attachment for freight warehouse and baggage scales for weighing L. C. L. freight. Represented by Fred Cruikshank, Fred H. Nemitz, Geo. Goetz, Chas. Gordon. Spaces 199 and 200, Annex.

Templeton, Kenly & Co., Ltd., Chicago.—Simplex track and car jacks. Represented by A. E. Barron, J. H. Hummel, W, B. Templeton. Space 126.

Union Fibre Company, Winona, Minn.—Linofelt insulating quilt for covering ice house, Linofelt sound deadening quilt for office buildings and other structures, waterproof lith board for insulating ice houses and cold storages! refrigator Linofelt for insulating refrigator cars. Represented by F. J. Bingham, S. E. McPartlin, H. W. Leeds, J. H. Bracken. Space 171.

Union Switch & Signal Co., Swissvale, Pa.—Interlocking and signaling apparatus for steam and electric railways, including electro-pneumatic and electric interlockings in operation; signals, relays and other apparatus for A. C. or D. C. automatic block signaling; staff system and other controlled manual apparatus; electric crossing gates and bells; Keystone insulated rail joints; mechanical interlocking details, etc. Represented by H. G. Prout, J. G. Schreuder, J. S. Hobson, S. G. Johnson, J. P. Coleman, M. D. Hanlon, L. F. Howard, T. H. Patenall, W. H. Cadewallader, J. D. Taylor, H. McCready, W. E. Foster, George Blackmore, W. M. Vandersluis, C. C. White, H. S. Beakes, E. T. Barnes. Space 42-43.

U. S. Metal & Manufacturing Co., New York.—"Diamond" tapered steel poles; Wolfe automatic rail joint lock; Columbia lock nuts. Represented by B. A. Hegeman, Jr. F. C. Dunham, H. A. Hegeman, Arthur Masters. Space 18.

U. S. Wind Engine & Pump Co., Batavia, Ill.—Water columns, tanks, tank fixtures, steel substructures (all in model); switch stands. Represented by L. E. Wolcott, A. J. Anderson, C. E. Ward. Space 111.

Wm. Wharton Jr., & Company, Inc., Philadelphia, Pa.—Manganese steel switches, frogs, crossings, and movable points; switch stands, guard rail clamps, anti-creepers, models, photographs, etc. Represented by V. Angerer, L. R. Ashhurst, Jr. R. C. McCloy, W. B. Cooke, W. McLain, Arthur S. Partridge. Spaces 9-10-27-28 and 29.

Weir & Craig Manufacturing Co., Chicago.—Electric turntable tractors; compressed air turntable tractors; electric portable hoists; compressed air portable hoists; locomotive drop pit jacks (pneumatic and hydraulic). Represented by Fred G. Whipple, R. W. Young, J. D. Granville, H. B. Shreve. Space 143.

Weisell Nut Lock Company, Chicago.—A nut lock in the form of a lock nut, which depends upon a wedge principle. It follows the thread of the bolt into the head of the nut, operating as a wedge-fulcrum. Represented by C. J. Grady, S. Glenn Andrus, T. Turner. One-half of space 201.

C. H. Whall & Company, Boston.—"Whall's Special Railroad Fibre" for insulating rail joints, etc., and fuses for train protection. Represented by F. R. Whall, John B. Given. Space 127.

Winans Improved Patent Rail-Joint Co., Portland, Ore.—A base supported rail joint. Represented by Audubon Winans. Space 185½.

Winters-Coleman Scale Company, Springfield, Ohio.—Automatic weighing machinery; Osgood and Sonander systems. Represented by Randolph Coleman, H. B. Osgood, C. F. Byerly. Spaces 107 and 108.

Worth Wire Works, Kokomo, Ind.—Demonstrating the appli-

cation of the "Cinch" fence stay, as used on railroad right-of-way fencing, to keep the line wires from spreading or sagging, at a minimum number of posts. Represented by O. H. Buck, W. N. Hall, F. Craig. Space 219.

Lewis Wylder, Cathay, N. D.—Models in reinforced concrete and metal railway ties. Represented by Lewis Wylder. Space 221.

Yale & Towne Manufacturing Co., New York.—Triplex blocks, padlocks, door checks. Represented by R. E. Gedney, C. H. VanWinkle, D. A. Wright, R. Kleinsmid, H. R. Butler. Space 152.

THE SHANTUNG RAILWAY.

The lease of Kiaochow by Germany in 1898 for 99 years was the outcome of the murder of two German missionaries in the province of Shantung in 1897. The commander of the German squadron took possession and a demand was made on the Peking government for the punishment of the governor of Shantung, an indemnity to the families of the victims and an amount to reimburse Germany for the cost of occupation, besides securing a preference for German railway enterprise in that province. These demands were acceded to, and with the signing of the lease a railway convention was concluded providing for the construction by Germany of two lines of railway in Shantung. One from Kiaochow and Tsinan-fu to the boundary of Shantung province, via Wei-hsien, Tsinchow, Pashan, Tsechuen and Suiping; the second to connect Kiaochow with Chinchow.

In order to carry out the railway work a Chino-German company was formed, and in this company both German and Chinese subjects were at liberty to invest money and appoint directors for the management of the undertaking.

It was also provided that if at any time the Chinese should form schemes for the development of Shantung, for the execution of which it is necessary to obtain foreign capital, the Chinese government, or whatever Chinese may be interested in such schemes, shall, in the first instance, apply to German capitalists. Application shall also be made to German manufacturers for the necessary machinery and materials before the manufacturers of any other nation are approached. Should German capitalists or manufacturers decline to take up the business, the Chinese shall then be at liberty to obtain money and materials from sources of other nationality than German.

A company to be known as the Shantung Eisenbahn Gesellschaft was organized at Berlin with a capital of 54,000,000 marks ($13,000,000). By its concession the syndicate was to build a line from Tsingtau to Kiaochow, and from the latter point by way of Weihsien to Chinanfu, together with a branch to Poshan, within a period of five years. The main line was completed in 1904, a distance in all of 240 miles. The branch to Poshun is 34 miles in length, making, in all, 274 miles approximately. The proposed line between Ichowfu and Chinanfu was abandoned in favor of the Anglo-German syndicate in connection with the construction of the Tientsin-Pukow line. The Kiaochow-Ichowfu line was surveyed, but further work was abandoned. The cost of the line was approximately $47,500 a mile. The editor of the London and China Express, who visited Shantung in 1907, made the following report:

"The Shantung railway is standard gage and the rails are laid on iron ties. Moderate weight rails are employed, and at present no fast speeds are attempted. The journey takes 13 hours, of which nearly three hours were stops. The stations are good, useful buildings, without ostentation. The bridge work over the many shallow rivers and streams, which in the rainy season often become raging torrents for a short time, is fairly solid, and the roadbed in good order. According to the last available figures, those for 1906, the stock comprised 30 locomotives, 107 passenger and baggage cars, and 720 freight cars.

Proceedings

The March meeting of the Railway Signal Association began at 10:20 A. M., Monday, March 14, at the Congress Hotel, Chicago, being called to order by Vice President C. E. Denney (L. S. & M. S.).

The first standing committee report was that of Committee No. 1, on Signaling Practice. The chairman, A. H. Rudd (Penna. R. R.), read the following progress report on upper left hand quadrant signals, making certain comments, as indicated.

In response to a circular letter, twenty-six replies were received, and only two or three signal engineers took interest enough in the subject to answer. The committee, decided to report against recommending the use of upper left hand quadrant signals for the following reasons:

While the upper right hand quadrant meets the requisites of the American Railway Association, the upper left hand is not in accord with them, and we believe that unless very decided advantages are shown for the use of the upper left hand over those of the upper right hand, the effort (involving as it must, a large amount of discussion and labor to induce the American Railway Association to change its requisites) would not be warranted. The Railway Signal Association has already by a large vote recommended the upper right hand quadrant, as also has the American Railway Engineering and Maintenance of Way Association, and these recommendations should not be changed unless, as cited before, very decided advantages are shown. From the data at hand, the committee did not feel that these advantages were developed. It is doubtless the case that if left hand quadrant signals had been used from the inception of signaling in the United States a great many situations would have developed and, in fact, some have been brought to the attention of the committee where upper right hand quadrant signals would have been more advantageous On the other hand, the situations where the upper left hand would be of advantage are so few in comparison with the number of signals already installed, that a change is not, in our opinion, warranted. Several cases have been cited where right hand signals are now located on through bridges, the arm being very difficult to discern, as it sticks through and outside of the bridge structure. Attention is drawn to the fact that if left hand signals were used the arm could be seen. In several of these cases if the arm projected to the left it would have been struck by passing trains, specially if signals carrying more than one arm were used.

(Mr. Rudd: As far as I have been able to reach the committee, all the members are against the upper left hand quadrant, as well as the chairmen of Committees 2, 3 and 4. I have not heard yet from Messrs. Patenall, Ingalls, or Temple. They voted against it.)

The change to upper right hand is entirely possible at isolated interlockings or for block signals on short stretches of road, and its installation has been proved not to be confusing where upper right hand and lower right hand are used indiscriminately. With upper left hand, in the opinion of our committee, the danger which might develop through enginemen reading the back of one signal in the lower quadrant for the front of another signal in the upper quadrant, especially if arms were not kept very brightly painted, would be so considerable that signals would have to be changed on only one engine division at a time, at least. The cost of this change would be prohibitive, while if upper right hand signals are installed no such change is required, and they may be put in for new work and renewals without extra expense. The men are educated to the arm projecting to the right of the mast, and if a change were made they would have to be re-educated. Even then, their old habits of thought might prevail and cause trouble. In the country districts especially, bad locations can generally be avoided by care in placing the signals and in the few cases where the nature of the surroundings makes necessary locations so that signals cannot properly be seen, adequate approach information in the shape of distant signals will, in the opinion of the committee, minimize this difficulty.

(Mr. Rudd: I might say that the members who signed the minority report of Committee No. 1 of last year, have not seen this, and it is possible that some of these reasons they might not endorse, but they endorse the position of the committee against the upper left hand quadrant.)

While the point has been made that telegraph lines, power lines, overhead trolley construction, etc., are increasing to such a degree as to require upper left hand signals, it develops that the only road using such construction at present

has decided on the so-called upper left hand quadrant signal which is pivoted on center and is half upper left hand and half lower right hand in its indication, although, in the clear position, it stands well out to the left of the post. In the stop position only half the arm projects to the left. It is possible that left hand signals may be used on trolley roads but, in the opinion of the committee, as above cited, obstructions of telegraph lines, power lines, etc., in the open country are not serious and in congested districts, the tendency is to put such wires underground and remove them from places where they will conflict with the sight of signals and further, while it is possible that the steam roads in electrifying will use overhead construction and will employ trolley wires for transmitting their power to the motors, we believe that with the exception of the one road in question, the recent installations have been largely of the protected third rail type which does not obstruct the view of signals. All things considered, therefore, unless stronger points are brought out in favor of this radical change than those already presented, we are of the opinion that the action of the association should be adhered to and upper right hand rather than upper left hand quadrant signals should be used for all new work and renewals.

Mr. Rudd: After this report was made we had a letter from a signal engineer, in which he called attention to the train order signals, two arms on one post, one to the right and one to the left, on single track, with trains moving in both directions, the use of the upper left hand on those two arms might cause very serious confusion. The following progress report of Sub-Committee No. 1 is an outline of the work done since the annual meeting in November, 1909.

The sub-committee submits six plans, described as follows:

No. 1026. Ladders for ground masts for mechanical signals.

No. 1029. Ladder clamps and stays. This drawing combines Nos. 1028 and 1029 of the 1908 issue, and includes the dimension table for clamps and stays for all sizes of masts, including the bracket post. The design is unchanged, and, therefore, no confliction can arise in ordering from either the 1908 or 1910 issues.

No. 1035. Ground signal masts, including base and pinnacle; also No. 1037, bracket post and bridge signal mast. These two drawings fix the distance between signal arms, the height of pole, height of mast, sizes of pipe, and give an outline of the base and pinnacle. The posts are made of two sections, and, in the case of the ground signal mast, they are made of two pieces of pipe instead of three, as shown in the issue of 1908. It is obvious that the use of 5-in. pipe throughout for the fastening of all connections will reduce to a minium the number of parts in signal fittings. As most all ground masts for mechanical signals are now made of three sections of pipe, in practically all cases it requires two sizes of fittings to equip a three-arm mast. This change will not require greater quantities of material than heretofore, and should eventually simplify the subject of signal fittings.

No. 1036. Base for bracket and bridge signal mast. Sketches in sufficient detail have been worked out to show that the offset base, which is submitted for approval, has advantages in the lead of mechanical connections to bracket posts and bridges. The sub-committee has not had time to prepare drawings of all the fittings to submit for approval, but details can be worked out with this design in a most satisfactory manner.

No. 1040. Pinnacle casting. Investigations with the manufacturers developed the fact that the General Electric Company and the Hall Signal Company would require a shorter pinnacle to conform to the dimensions shown on plan No. 1035 and plan No. 1037. The sub-committee has prepared a drawing, which it is ready to submit to the whole committee, along the same design as this pinnacle, but 5 in. shorter, so that any signal engineer who requires the actual dimensions and finds it necessary to put two or more different designs of signals on a bridge can have the top of masts exactly the same height.

In addition to these drawings, which have been approved by Committee No. 1, the sub-committee has prepared drawing and specifications for standard semaphore lamp, and for font; design of bracket post and ladders; design for platforms for bracket post; and base for bracket post.

We have under consideration the subject of specifications for zinc, copper clad bond wires, 1-in. wrought iron pipe, design for bolt locks, facing point locks, pipe carriers, and switch lamp, and will present for approval, if the association so desires, recommendation for standard binding post. The bracket post has received a good deal of attention, and the designs have been submitted, or are in the hands of the bridge engineers of the different roads represented by your committee members. As soon as the reports from all bridge engineers are received, a drawing will be presented for the approval of the whole committee, and we hope to have it in shape for presentation at the next stated meeting of the association. (The full committee, at Buffalo, gave the sub-committee instructions to make this drawing and that has been done.)

T. S. Stevens (A., T. & S. F.): Mr. Rudd has, with my consent, used my name in connection with the report about the upper left-hand quadrant. I believe the report in a sense is all right, but I do not think it would be worded exactly as it is, because I do not think that association can afford to condemn unqualifiedly the upper left hand quadrant. They can say it is not advisable to recommend it. I know that on the Santa Fe to-day I would be very glad if we had the upper left hand quadrant; we would have better signals unquestionably, but I know I can't get it; there is too much of the other. Appreciate what the committee says is true, that you cannot mix the two together without dangerous confusion. I do not suppose this meeting here can take any action. I would earnestly recommend that when the report is made at the annual meeting it does not condemn the upper left hand quadrant, but simply refer to the fact that this association does not think it proper to recommend it at the present time.

The Vice-President: I believe that that is the intention of the progress report, although, as you say, it may be advisable to change the wording. I assume that the committee will reconsider that feature before submitting the report to the annual meeting.

Mr. Rudd: Mr. Stevens' position is very tenable. This was drawn up without submitting it to the full committee by the chairman, on the basis of the arguments that were made at the meeting in Buffalo. I reported as nearly as I could the facts that were brought out at Buffalo and it is simply a progress report for the information of this association as to what the committee is doing. When the full report is made and approved by the entire committee I have no doubt they will change this paragraph. I don't imagine it will be necessary to publish this report in detail in the proceedings. That is the reason it wasn't printed. It was submitted for information, to give us time to talk the matter over and settle on the final report. I hope there will be some discussion on the particular castings recommended for use, and on the spacing arm. I ask this perhaps in a personal way. We are about to adopt a right-hand quadrant for our new work. We have a casting of our own, a type of our own that we have used on a small amount of upper quadrant work that has been done, and it looks as if we were going to have considerable work this year. I want to start right, and if there is any probable change of this association adopting the castings which have been submitted by the sub-committee, I want to alter my new work. If there is not a chance, I wish to stick to the old castings until something is settled, and that may be a couple of years or so.

Mr. Stevens: The Santa Fe has adopted the castings recommended by the committee, so far as the top arm is concerned. So far as the spacing of the arms is concerned, I shall always oppose the introduction of a third arm on a single mast so close to the two main arms. It is confusing and dangerous. The two arms are quite enough; we certainly ought not to go to three. While I have approved these drawings, as a member of the sub-committee, it has been with a view to accepting Nos. 1 and 2, feeling that I would never accept No. 3.

J. C. Mock (Detroit River Tunnel Co.): It seems to me that this is the place where we ought to discuss the designs that are proposed here as standards, but I should suggest that we take this up in the regular way. Regarding the first drawing, we want all signal engineers to feel that this is the best it is possible to get. The sub-committee cannot correspond with all the signal engineers in the United States, so I would like very much if this meeting could be considered in the nature of a committee meeting, and the members here instruct the sub-committee as to what they wish. I propose that this plan No. 1026 be approved and presented to the annual meeting as a standard.

A. G. Shaver (C., R. I. & P.): Will Mr. Mock kindly explain the difference between this plan and the one adopted? I understood from Mr. Rudd that there is very little difference, if any.

Mr. Mock: The difference is due to the fact that we have a post composed of two pieces of pipe. The spacing of these stays is a little greater; the distance between rungs is the same; the material from which the ladder is made is the same. In No. 1, the section is used for No. 2 and No. 3, with an additional section at the base to make up the necessary length. The slope is the same, but in working out the details of this new post there is a slight variation. It may not be

possible to put this ladder on the old pole and have the stays all fit, because of that change in the pipe section.

Mr. Shaver: I move that plan No. 1026 be accepted and approved by the meeting, with recommendation to the annual meeting that it be adopted.

L. S. Rose (C., C., C. & St. L.): I would like to know if anyone has made a post after this plan.

F. T. Patenall (B. & O.): This type of post, as far as my memory serves me, has been in use on several roads for the last ten years, so there will be no difficulty in its adoption so far as its construction is concerned.

Mr. Rose: About a year ago a post was adopted, which had a 4-in. top, and now we have proposed a post which has a 5-in. top. We have a great many signals fitted in the 4-in. post and do not want to change unless it is right.

Mr. Mock: I believe the report neglected to explain the reason for that change. I think it is possible that the two sections of pipe will reduce the number of pieces you will have to carry in fitting up a signal post. This base will take a certain casting and then all the other fittings will be on the 5-inch section. As pointed out in that letter, the present three-arm mast will require both the 5-in. and 4-in. fitting, whereas now we can use some of the 5-in. fittings for everything except the base stand. It makes a little better post, I believe, but the principal object is to get as few parts as practicable, when we come to work out the details of post fittings. It does not necessarily interfere, seriously, with what is now in service, namely the three sections: 4-in., 5-in. and 6-in.

Mr. Rudd: I think the question of spacing the arms is very important and should be discussed. We have found it necessary to use three signals on the P. R. R. for the last seven years. We use two arms, 6 ft., or, in some cases, 6 ft. 6 in. apart at the top and the lower arm 10 or 11 feet below that, so the third arm is quite a distance from the others. We found the spacing very satisfactory. The committee recommends that the spacings shall be 7 ft. and 6 ft.; that is, that the third arm shall be closer to the second arm than the second arm is to the first arm, so that in the upper quadrant the distance between the end of the second arm, when clear, and the top arm, and the distance between the end of the third arm, when clear, and the second arm shall be the same. I do not know whether I would be able to get our people to change our standard or not, but if the association votes to have that standard changed, I shall do the best I can to have it carried out. I do not think the matter should be rushed, and I think we should have some discussion as to whether it is safe to bring the third arm up so close to the second arm. Mr. Stevens says he does not think it is. He does not want to use the third arm in any event, but if he should use it he thinks the distance should be greater in the transition stage from the lower quadrant to the upper. If three arms are used, it would probably be necessary to have the three lights red, as it would be unwise to make the third light purple during the transition. I am not opposing this change, but I think that the matter should be very fully and freely discussed.

Mr. Mock: When the lower arm is 22 ft. 6 in. from the base of the pole, it is 22 ft. from the center of the arm to the top of the rail, figuring a 6-in. rail. The lowering of the third arm to a height which is not clear will require more spread of track in some places, and it will also be very difficult to establish standards for every rail. Take the bracket and the bridge mast: with a third arm at the bridge strut, it must be at least 21 ft. high and I believe in any design that is now felt to be good practice it would be at least 21 ft. Now, the practice, I believe, on the Pennsylvania is to put the third arm in the bridge truss, and that raises it to approximately 24 ft., so that the scheme of extra spacing between the second and third arm will require very high signals in order to bring the third arm to a reasonable height to show it above the cars, when on a curve, and with signal space between the main track and the side track. On bridge and bracket masts you will reduce it.

Mr. Stevens: I do not like to see this matter passed over in this way. There is a question involved which should be discussed. Some years ago we practically determined that a post with only two high arms on a signal mast was the best practice, and now we are practically recommending the adoption of a post with three arms. We recommend the two high arms for the purpose of reducing the possibilities of confusion, the possibilities of a man receiving a normal route signal, or normal speed signal, or some other high speed indication from a clear light on the second arm, when the top arm is out. All the theories we have advanced in the last two or three years have been with the idea of eliminating the possibilities of confusion with the lights out, yet the association has under consideration the recommendation that a further possibility of this kind shall be introduced in our signal practice. I should like to hear some discussion, even if we cannot take any definite action, on the advisability of the use of the three-arm signal.

Mr. Rudd: I hardly think this is the time to discuss the report of Committee No. 1, which has been rejected. There are railways that are using three-arm signals to-day, there are roads that are using two-arm signals, and there are roads that are using only one-arm signals, and the plan under discussion provides for ladders for the different signals in use.

It seems to me that the vote on the question confines itself to whether this is a proper construction of ladders to be used on various signals. If we can decide that the construction of the ladders is correct, the length of the ladder will be governed by the height of the signal.

Plan 2026 was adopted and recommended for adoption at the annual convention.

The Vice-President: Plan 1029 is almost a part of 1026, as it shows the clamps and stays for the ladders which we have now approved.

Mr. Mock: I move that plan No. 1029 be approved. This design has not been changed, the table of dimensions have been extended to cover stays and clamps for 9-in. and 10-in. type, and also the swedged joint of the 6-in. pipe. It is also true of the dimension table for the stays.

Motion carried.

The Vice-President: I think the meeting can fairly look at plan No. 1035 as a method of design for one, two and three-arm signals. We can hardly decide whether the Association shall recommend the use of the three-arm signal, just as shown, until the report is approved, but we can say that the meeting approves the general design of the pole if a three-arm pole is to be used.

The three-arm plan, No. 1035, was approved.

Mr. Mock: I move that plan No. 1036 be approved.

Mr. Rudd: I second the motion.

J. V. Young (B. & M.): I would like to hear the advantages of the off-set casting explained.

Mr. Mock: Your sub-committee has been working very closely with the manufacturers and it hears the complaints and sees the advantages of certain little changes in the method of running connections to a bracket post or to a bridge mast. In working up the leads for bracket posts with three-arm masts or two-arm masts, the castings clamped to the base work out with less off-set to the pipe by using this design. The bolt holes are spaced the same as in the old base, but there is a chance for a slight shifting of the base in case bolt holes are not accurately spaced. You can get your alinement by shifting the posts or slotting the posts.

The Vice-President: You have heard the motion for the adoption of plan 1036. Plan 1037 is in accordance with plan 1035, which has been adopted, except the dimension from base to center of bottom arm, and shows the proposed design for a bracket post and bridge signal mast. Is there a motion for the adoption of 1037?

Mr. Mock: I so move.

Motion carried.

Mr. Mock: I move the adoption of the pinnacle shown on plan 1040, and I have blue prints here showing a design along the same lines as that shown on 1040, except that it is 5 in. shorter to permit the general and the top post mechanism of the signals to be placed alongside of any other signal and to bring the tops exactly the same height. If any road should want to reduce the height of the pinnacle, even in any other design, they can do so by using this one. The shorter pinnacle is 18 in. over all, whereas the one shown in No. 1040 is 23 in. I move the approval of the shorter pinnacle as well.

Motion seconded.

The Vice President: I don't see that we can vote for the adoption of the plan if it has not been submitted to the meeting, although in voting on this it should be understood there will be another pinnacle submitted by the committee at a later meeting, probably the annual meeting, which will be 5 in. shorter than the one shown.

Mr. Rudd: Mr. Chairman, I think we can very well vote on both plans. Of course the second plan is secret. We have not all seen it, but it is very plain. If this pinnacle suits the majority of the members, undoubtedly the other will also, though 5 in. shorter, for the reasons explained. We cannot take any definite action any way. If the sentiment of the meeting is in favor of two pinnacles along this line, I think we ought to express it.

Mr. Mock: I withdraw the motion about the adoption of the shorter one. Perhaps it is best to separate it. If we adopt No. 1040 I think the other will follow. The committee

would like to have instructions as to whether it should change the second design.

Plan No. 1040 was adopted.

Mr. Rudd: I move that Committee No. 1 be instructed to submit drawings for a second pinnacle, 5 in. shorter than this, on substantially these lines.

Motion carried.

Mr. Rudd: I would ask, if not entirely out of order, for a vote on the design submitted at the last association meeting, which was not acted on, for the extra casting. All the members have seen that and I would be very glad if we could get an expression of opinion from them as to the advisability of that design as against any other. I move that the design for the upper casting, the three-arm mast, 9-a, drawing No. 1040 in the annual proceedings, on page 417 of the journal of the annual meeting, be approved.

Mr. Shaver: Has the committee tried this spectacle in actual service? It looks to me as though the design may be just a little bit light, particularly as to standing considerable wind pressures, to which these are subjected in some territories.

Mr. Patenall: I do not think there is any trouble in reference to the strength of castings. In fact, the majority of these spectacles are being built now with the spectacle of pressed steel, mounted on malleable iron or cast steel. We had quite a number of both types in service for two or three years, and have experienced no trouble such as mentioned by Mr. Shaver.

Mr. Shaver: I don't know that Mr. Patenall gets the point I make. I am aware there is a cast hub used for this spectacle, but it seems to me the pressed steel part is a little light. Such a spectacle as the association adopts should be one that can be used with either mechanical or automatic signals, and I am of the opinion that this spectacle may be found a little too light in service for mechanical connections.

The Vice-President: The plan referred to does not specify the thickness of a cast spectacle, nor does it specify the thickness of metal, if used; simply shows an outline of a punching, if one is desired.

Mr. Rudd: I would like to get advice on the general design of castings. We are using today practically the design shown on the cover of our Journal. If there is any chance of this association adopting Mr. Patenall's design we want to use it. If a majority of the members are opposed to the design submitted last October I want to know it, and we will keep on with what we have got.

Mr. Shaver. I wish it to be understood that it is the general design of the spectacle that I find unsatisfactory. I believe, from tests which we have made, that the Railway Signal Association design gives much the better curve

Mr. Patenall: The design shown on plan No. 1040, referred to in Mr. Rudd's motion, carries with it certain location of stops. But, as I understand the situation, Mr. Rudd simply desires a vote as to the general design of the casting, or rather the spectacle, and not as to its location of stops, as shown on that plan.

Mr. Rudd: This, as I said, is a personal matter, but I would like to get a general expression as to whether that general design is preferable.

The Vice-President: Do you wish to change your motion?

Mr. Rudd: If necessary to bring that out. I want to find out whether the general design of 1040, 9-a, is preferable to any other design submitted.

Motion as amended seconded.

W. H. Lane (Hall Signal Co.): There has been no design submitted before Sub-committee No. 1 about which there is so much discussion, and there has been no part discussed at any meeting of that sub-committee that was gone into so thoroughly, as the design of the castings for quadrant signal. The design shown, on which we are now voting, was adopted by Sub-committee No. 1, after most thorough discussion, largely for the reason that the short curve was shown to be better than any other design submitted. The fact that we have almost a maximum weight with the signals clear, and about the same weight with the signal at 45 deg., makes it the best design, in the opinion of the sub-committee, and I think those points should be taken into consideration.

Mr. Rudd's motion was adopted.

Mr. Mock: As a matter of guidance for this sub-committee in its future work in presenting plans before the next stated meeting for discussion, we are ready to submit plans for a standard lamp. We have under consideration a lamp with two hoods, which may take a lens of either size, so that it can be reversed, accordingly as it is placed on the left side or the right side of the pole, as is required in the scheme of signals. I have prints with me showing a lamp which has a door opening at the rear, or opposite the lens. The ordinary arrangement is to have the door at the side, on a 90-deg. angle. If this committee has any time to discuss the relative merits of these two arrangements, I should like to have an expression of opinion.

The Vice-President: We have just given about an hour to the discussion of the plans. I don't believe we can spare any more time, although I see your position.

The next committee report was that of Committee No. 2, on Mechanical Interlocking, C. J. Kelloway (A. C. L.), Chairman. This committee made a progress report.

The next report was that of Committee No. 3, Power Interlocking, B. H. Mann (Mo. Pac.), Chairman.

Mr. Mann: We assume that the association will be particularly interested in the experiment as to neighborhood meetings that the executive committee and, through the committee, the president, has authorized. The purpose is to expedite the work at the annual meeting, and insure that the report as adopted at the annual meeting is a clear expression of the wish, not only of one neighborhood but of each neighborhood as represented in the association. To carry out this idea this committee has been divided into five sub-committees. The neighborhoods covered so far have been: New York, W. F. Follett (N. Y., N. H. & H.); Northern New York, W. H. Harland (N. Y., O. & W.); Pittsburgh and adjacent territory, A. R. Rayner (P. & L. E.); Ohio, Michigan and Northern Indiana, F. B. Wiegand (L. S. & M. S.); west of the Mississippi river, W. H. Arkenburg (C., R. I. & P.). Personally, I am enthusiastic over the neighborhood idea, and assume that the sub-committee chairmen who have handled the work in their own neighborhoods can best give their individual opinions. Mr. Johnson, of the New York Central, is here, and can give the New York idea.

R. C. Johnson: The New York sub-committee has in charge the drawing of specifications for electric pneumatic interlocking. We are following the same plan or idea as to electric interlocking specifications, adopting the same specification where it applies, and adding to or subtracting from it where it conflicts. We expect to have the whole subject covered and have the complete specifications ready for the annual meeting.

Mr. Arkenburg: We have had two meetings. The neighborhood idea has worked out very well in our case. At the first meeting we had, I think, five outsiders present; at the second, two. We were discussing mainly the subject of indication in connection with power interlocking in general, and also the advisability of some means of locking the switch electrically, thereby performing the same function that the mechanical bolt lock now does in the mechanical interlocking plant. The first meeting was taken up more or less with organization, although there was some discussion, and at the second one the electric bolt lock in connection with mechanical interlocking plant was discussed.

Mr. Wiegand: Sub-committee No. 3 has held one meeting. The work of handling subjects (f), (j), (k), (l) and (m) was divided, a portion being assigned to each member. Several plans of circuits for replacing defective bars were received from various roads, but not much time has been devoted to them. We have also received several circulars from which several plans of typical wood-locking circuits have been drawn, typical circuits for a single switch of three types of power interlocking have also been drawn up.

Mr. Mann: Every signal engineer, or other man on the road in charge of this line of work, who is not a member of this committee, can, by consulting with the representative of his road before the meetings, know just the line of work. Five or six copies of the minutes are made and each sub-committee chairman can then take the typewritten copy and blue print it, attach his remarks as he would like to have them handled by his sub-committee and forward it in advance of his meeting to each of his sub-committee members; so that at the sub-committee meetings he feels that each of his members comes prepared for the discussion from his individual point of view, and also from the point of view of the road he represents.

I. S. Raymer (P. & L. E.): The idea of the neighborhood meeting worked out well in our case. We have on our sub-committee three or four members, all in Pittsburgh. We meet every Friday afternoon for an hour or so and discuss the subject that comes up at the time. We have taken up that troublesome question of trying to get some favorable way of carrying the electricity from the power out to the function. We are working on underground transmission, with wooden conduits, wires covered with an asphaltum or a pitch. We believe we have something that will be very good. In booths Nos. 42 and 43 at the Coliseum there is on

exhibition a piece of trunking taken out of the ground in March, 1910, put in in 1891, nineteen years ago. In the trunking is a four-wire cable, entirely covered with pitch. The cable is in an excellent condition of preservation. We believe we will be able to draw up specifications that will give us a good means of transmitting electric power to the functions on the ground.

The next report was that of Committee No. 4, Automatic Block, A. G. Shaver (C. R. I. & P.), Chairman. This committee made a progress report.

Committee No. 5, Manual Block, L. R. Mann (Mo. Pac.), vice-chairman; Committee No. 6, Automatic Stop and Cab Signals (N. Y. C. & H. R.), Chairman; Committee No. 7, Subjects and Definitions, C. C. Anthony (Penna. R. R.), chairman; Committee No. 9, Wires and Cables, W. H. Elliott (N. Y. C. & H. R.), chairman; Committee No. 10, Electric Signaling for Electric Railways, C. C. Rosenberg, chairman; Special Committee on Promotion of Signaling Education, W. J. Eck (Southern), chairman; Special Committee on Methods of Recording Signal Failures, J. C. Young (Un. Pac.), chairman; Special Committee on Lightning Arresters, Charles Stevens (C. & O.), chairman; and the Special Committee on Storage Battery, A. H. Yocum (P. & R.), chairman, all made progress reports.

T. S. Stephens (A. T. & S. F.): I would like to draw the attention of the members to the desirability of this neighborhood meeting idea. We have a member on nearly all the committees, specification committee especially, and I have instructed those men they shall attend any sub-committee meeting which they can reach in one night's travel. They are interested individually, and we are interested as a railway in being represented on these committees, and have our men attend meetings, if meetings can be held at such a place that these men will not be taken away from their work for a long time. That is a thing which I think will perfect our committee work and bring us all to our annual meetings without such an awful lot of stuff to discuss.

The Vice-President: I think we are all in sympathy with the neighborhood meeting idea. It may be that some of the chairmen of committees who have not already arranged for this year's work will find it advisable. I know that Committee No. 1 did some very good work because the men could get together without traveling very far. A one night's trip does not amount to much. The Committee on Electrical Interlocking has carried it out in fine shape and I believe the idea will grow on us and bring about a lot of good and cut down discussions at the annual meeting which has hampered our work, although at every annual meeting we have been improving along that line.

Mr. Rudd: I believe that not only the neighborhood meetings but the principle of them should be extended. When the chairman of the committee sends to the members the matters to be thought over and discussed the members ought to get into communication with the other members. The views of every member ought to be represented in the committee work, and if each member will make up his mind that he is somebody on that committee and work as hard as any other member, we will get better representative reports than we have ever gotten before.

The secretary then read a paper by Otto Holstein, chief train despatcher, Central of Peru, on Lightning Protection. Mr. Holstein first described the severe electrical storms in Peru, particularly in the territory served by the Cerro de Pasco and the Central of Peru.

A lightning arrester, known as the "Argus," is used on the Cerro de Pasco, for the protection of telegraph and telephone apparatus, and also for the protection of the train staff machines, which are in use there. In the case of the telegraph, these arresters have done excellent work. During one storm at Carhuamayo, a station on the Cerro de Pasco, the lightning arrester was completely destroyed by a heavy discharge while the telegraph relay was not damaged. During another storm at La Fundicion, on the same road, the helix of the arrester was fused, but no damage was suffered by the telegraph apparatus.

The results obtained in the case of the telegraphones were not so gratifying as in the case of the telegraph apparatus, for, although the current that got through the arrester before it reached an intensity sufficient to break down the resistance of the air gap between the helix and the ground plate, and was not sufficient to cause any damage to the telegraph relays, it was sufficient to puncture the comparatively delicate oiled paper tinfoil condensers used to bridge telegraph instruments in intermediate offices and in telegraphone circuits where these instruments were installed. We finally put two-pole single-throw cut-out switches in all telegraphone circuits as well as in condenser circuits at intermediate offices, with instructions to open switches on first appearance of a storm.

On the Central of Peru I found a type of lightning arrester that was entirely new to me. The arrester in question embodies many good features, and its performance has been quite satisfactory on this road, where very trying conditions are to be met.

The principal parts of this arrester are of cast iron; the arrester shown in the accompanying diagram is of the two-line type.

The ground plate measures 7¾ in. x 6 5-16 in. and stands on four legs cast with the plate. The whole upper surface of this plate is furrowed and sharply ridged, as shown in the profile of the ground plate. The line plates are likewise furrowed. The arrester, when assembled, has these sharp ridges at right angles, making every point of intersection (of which there are thousands) a spark-gap with an air space of but 1-32 in. to break down. As can be seen, thousands of small spark-gaps in multiple, with but 1-32 in. of air resistance to break down, impose but a negligible resistance to a static discharge of any intensity.

The line plates and ground plate are separated by hard rubber or ebonite washers 1-32 in. thick and the line plates are held in position by sentinels of the same material which are secured to the ground plate and which clamp the washers in position. On the line plates brass lugs are secured which also serve to hold the line plates in position; these lugs are insulated from the ground plate by a strip of ebonite that extends along the sides of this plate. The plates to which the line is connected can be lifted from the ground plate for inspection or for cleaning without interfering with the working of the wires.

The only fault that can be found with these arresters is that it is rather heavy, the weight of the two-line type being about 15 lbs. The records of this road show excellent performance for this type. There are records of some violent storms where office and ground leads have been fused by static electricity but no instruments have been lost.

The original manner of connecting the arresters was to connect them in series with the line and instruments and, inasmuch as they appear to have done their work so connected, it might seem best to let well enough alone, but I have put choke coils in series with the line plates of the arresters and the instruments with a view of still further retarding the passage of the high-frequency discharge, causing the charge to bank up and break down the resistance of the arrester sooner than it would otherwise, thereby offering greater protection to the instruments. Good ground leads have also been sought and both binding posts of the ground plate have been connected with separate grounds. A flat copper ribbon being used for the ground conductor, this form of conductor appears to embody qualities not possessed by round conductors. As may be supposed, I am awaiting the result of these changes.

The Secretary: Committee No. 6 will meet tomorrow at 2 o'clock in room 1308 in this hotel. Committee No. 10 will meet at 2:30 tomorrow afternoon, and it is suggested that the members present meet in the lobby of the hotel, a room not having as yet been secured. Committee No. 2 will meet in the lobby at 2 p. m. tomorrow, a room not having been assigned. Sub-Committee A of Committee No. 3 will meet at the La Salle Street station, room 1125, at 10 o'clock tomorrow morning. The Special Committee on Lightning Arresters will meet at room 452 Auditorium Hotel, at 10 o'clock tomorrow morning. The Special Committee on Promotion of Signaling Education will meet this evening at 7:30 o'clock at the office of the signal engineer in the Monadnock block. Committee No. 4 will meet tomorrow at 9 o'clock in the La Salle Street station, room 1125.

Mr. Rudd: Committee No. 10, of the Maintenance of Way association, will meet at a place yet to be designated at 4 o'clock tomorrow afternoon in connection with Committee No. 1 of the Railway Signaling association. The discussion of the report of Committee No. 10, which is practically the report Committee No. 1 presented last fall and which was rejected, will be held before the Maintenance of Way association tomorrow morning.

A paper on Soda-Copper Oxide Primary Cell on Track Circuits, by E. L. Marshall (National Carbon Co.) was then presented.

The object of this paper is the discussion of primary batteries for track circuit work, attention being devoted principally to a comparison of the soda-copper oxide cell with the gravity cell. Since track conditions determine, in a large meas-

ure, the length of service life, Mr. Marshall considers first some questions relative to track circuits.

The drain upon a battery depends upon three factors: (a) Continuous drain through rails and relays: (b) Shunt drain when train is in the block. (c) Leakage. He gives formulas and tables for the values of factors (a) and (b). As to (c) leakage of current is the cause of high drain when the block is clear, and this leakage is increased by bad conditions, such as ballast in contact with the rails, grounded rails, ties saturated with brine, and switches. He discusses these with regard to their aggregate effect on the life of batteries. There have been three types of soda-copper oxide cells. The first type had low internal resistance. Since this cell was designed for gas engine ignition and for operating automatic block signals, it had a high current discharge, and consequently an external resistance had to be inserted to prevent excessive drain when the cells were employed on track circuits. To improve upon this type and remove the necessity for the addition of external resistance in the circuit a type was developed with a high internal resistance, due to the shape and position of its elements and to the insertion of a porcelain grid between them. This cell has given good service on track circuits, but because of its greater cost it could not compete with the gravity cell. Like all other soda cells then in use, it had the disadvantage of not giving any evidence as to when it was nearly exhausted, there being no visible end-point or any means of testing for it.

To incorporate the good points of the second type and give a visible means of determining its degree of exhaustion, a third type has been developed. He describes this cell in detail, the four particular advantages of it being the following:

(1) It has a visible indicator to show when the cell needs renewing. (2) This cell is non-freezing and non-congealing, thus decreasing the expense for battery chutes or wells to house track batteries below frost line. (3) The cell has long life, lessening the danger of failure and labor cost of inspecting and renewing. (4) Because of the long life and small number of renewals per year, the saving in materials alone per cell per year will be about $1.

Mr. Kelloway: Mr. Marshall says: "A very severe test of a soda battery was a case when a train stood in the block house three-quarters of an hour, but when the train left the block the relay picked up immediately, a performance that will equal that of any gravity cell." In the case of a train standing on a track a definite time the relay will pick up. I want to know whether the relay will pick up if the train stands two hours on the track.

Mr. Marshall: That has happened. A man told me that he had for six continuous days, at least, a train standing in the block for two hours, and he said that he had no trouble as the result of this delay. That happened since this paper was written. The cases in which they stay there for three-quarters of an hour are not unusual, but the other cases are exceptional, when there is an accident, or something unusual happens to delay the train, but this case, in particular, to which I refer, was brought to my attention and was authentic. The man was in charge of the batteries on the road on which that occurred.

Mr. Kelloway: Quite often you will have an engine out upon the track probably 80 per cent. of the time. Will not the soda cells exhaust very quickly under these conditions? You are likely to have a breakdown, holding the track there for one hour, two hours, or three or four hours. Under such circumstances, will not the cell have to be renewed?

Mr. Marshall: If the train stays on the block, the cell gives service as long as there is life in the cell. The train may stay there until the elements are almost used up, but if they are not actually exhausted it will pick up after the train leaves.

Mr. Stevens: I do not think there is any question about the relay picking up as long as there is any battery left. That is the theory of the soda cell. I want to commend in a few words the analytical nature of this paper. I think it is fine and should be a guide to some of our committeemen in making their reports to the association. We do not analyze things sufficiently. There is one thing, however, which I would like Mr. Marshall to explain, without going into too many details, and that is why the cell which he recommends will stand a lower temperature than the ordinary type of potash cell, if he can do that without divulging secrets.

Mr. Marshall: There is no secret about it. The idea is that the elements are separated much further than they are in all ordinary internal resistance cells. In the ordinary type of signal battery the elements are close together, and in that space between them there seems to be what they call congealing of the soda solution. The difference can only be explained, in my opinion, on the ground of the distance between them. The soda cell will not freeze in any case; it will congeal with extremely low temperature, but it congeals more readily in the signal type of cell, where the plates are close together, than where the plates are far apart. The elements are 3 in. apart in the track battery type, and they do not congeal.

Mr. Stevens: In California, where we have tried track circuits, we have made exhaustive tests on the use of potash cells. We are now using Edison B. S. C. O. cells, with an external resistance and get good results. We also have some of the Columbia cells in service there. It is a money saver, provided you can save labor and get about three months' life out of the battery. It is well worth looking into.

Mr. Elliott: The data given in this paper is very valuable and complete. At the same time, a little checking would seem to show that the apparent saving by the use of the primary cell would not be so great as shown. It is assumed that the cell will last for 91 days on an average consumption of 0.3 of an ampere of current. That is approximately what I find is the discharge of a battery on a track circuit of approximately 2,000 ft. or more in length. Certain track circuits have a resistance between rails of 2.5 ohms, and of course the leakage is excessive. I am speaking of the average. I doubt if the consumption of current or discharge in the track circuit is less than 0.3 of an ampere. On this basis, according to the figures of the paper, two cells of 700 ampere hours' combined capacity would last 91 days. It is later stated that the saving per year by the use of the cells by actual results is 69 cents; but figuring on the assumption or comparison made in the next paragraph the saving is shown at 97 cents. In the case of the soda cell, it is assumed that with 2.8 renewals, at 81 cents per renewal, the total cost of the soda cell would be $2.27 per year. This, evidently, is taken at a rate of consumption less than that given in the table where the batteries are shown to last 91 days. On a 91-day life of cells, practically four cells would be required for the year, and there would be no saving, and the expense would be $3.24, exactly the same as figured for the gravity battery. It would seem that the results shown are sufficient to warrant our looking into the matter and determine for ourselves what this cell will do. Undoubtedly, it would appear that if the cell will not depolarize when a train is on the track circuit for three or four hours, and the reduction in current from the cold weather will not be too great, the saving in labor will be such as to warrant the use of this primary cell.

Mr. Marshall: In regard to the price on this test, which you have spoken of in particular, that was assumed not from the drain but from what one road got on 65 different tests. I do not know what the drain of the track circuit was, or how many train movements there were. They got an average of 143 days' service, on 65 different tests, and that figure was computed from that data. If the drain was more severe, and they had more train movements, then the cost of gravity cells would also increase, the same as the cost on soda cells. We assume the cost of $3.24 on the gravity cells because they had that figure previous to the use of the soda cell; but if they had heavier traffic and poor track conditions they would undoubtedly get a higher cost on the gravity. The assumption of 0.3 of an ampere drain is based on a good many tests. We made tests of different conditions on a number of diferent railways, and we got that as being as close an average figure as we could possibly reach in our computation. The 91 days is really low, compared with what some roads are getting by the use of these batteries, but we figured on the safe side when we put it at 91 days. It has been rather above 90 days than under. We have some exceptions, but the average is far above.

Mr. Stevens: Even if we do not decrease the labor cost, we are gaining a whole lot if we do produce such conditions that a great part of the time of the men can be spent in testing the apparatus and seeing that it is working right.

The Vice-President: Under "Leakage," Mr. Marshall refers to grounded rails, saying: "By grounded rails we mean the use of any kind of 'anti-creeper' that extends from the rail down into the ballast, thus making good contact with the earth. The leakage which this practice causes is very serious, especially in wet weather." Nearly all the anti-

creepers on the market extend below the base of the rail. They are probably more successful in this than in keeping the rail from creeping. If this is true, about all we may get from a good many types of anti-creepers is leakage. If that fact had been definitely established, and this association should recommend that anti-creepers and apparatus of that sort should not extend below the base of the rail, a good many manufacturers and designers will have a hard proposition on their hands. I ask Mr. Marshall if he has made any test to definitely establish this fact, and if so, about how far below the base of the rail the anti-creepers extend, and how much the leakage was increased by the anti-creepers.

Mr. Marshall: The information came directly from your road, Mr. Chairman. I had occasion to investigate a very severe track drain, and in one case, at least, I think it was due to the anti-creepers. I brought this matter to the attention of the road and they were removed. The drain on that particular circuit was reduced from an average of about 0.7 of an ampere down to 0.5 of an ampere, and it is a very clear demonstration of the effect of the anti-creepers, because that is all that was done to the section.

Mr. Stevens: It would be interesting to know whether the anti-creepers were on a regularly ballasted section or not.

The Vice-President: I admit that what Mr. Marshall says is true. When this battery was first called to our attention we naturally put it on bad sections, and not good ones, because we could work good ones with almost anything. There was a complaint made about the anti-creepers, but I have not heard the result of the second test where the anti-creepers were removed. That would only be one case. Referring to Mr. Stevens' question, I did not see the section. They are on our eastbound track, which is affected a good deal by the brine from refrigerator cars, and on curves. I think the particular section was the first or second curve out of a heavy yard where all the trains were made up. The standard cross-section calls for about 1-in. clearance. The anti-creepers extend below the base of the rail, probably an inch and a half. It was gravel ballasted, but whether the gravel was below, or nearly below, the bottom of the anti-creepers, I do not know.

Mr. Marshall: I do not know of any other case in which the drain was reduced because of the anti-creepers, not having authentic figures, but I have heard indirectly that it happens where anti-creepers have been used.

The Vice-President: The question has been brought up by the Committee on Track of the Maintenance of Way Association at least once, and I believe they have made some recommendations on the subject.

L. S. Rose (C. C. & St. L.): The Track Committee brought in a recommendation that where there is a leakage of the track circuit the track fastenings shall be kept above the base of the rail. There are a good many designs of rail joints that hang below the base of the rail.

W. N. Manuel (G. R. & I.): How much time is required on short circuit to exhaust the cell?

Mr. Marshall: Do you mean direct short circuit from one contact to another?

Mr. Manuel: Yes.

Mr. Marshall: Off-hand, I could not tell you, but I think it is about three days. Of course, you never have that condition and cannot have it, because of the length of wire to the rails.

The Secretary: Prior to our general executive committee meeting, held in January, one of our members suggested that he thought it was desirable for the association to adopt a certificate of membership, to be issued to our members. The matter was given some consideraton by the executive committee, and was then turned over to Mr. Eck, of the Southern Railway, who has looked into the matter, and is now ready to make a report to the association.

Mr. Eck: Most of the larger associations, the American Society of Civil Engineers, the American Institute of Electrical Engineers and other similar bodies have a certificate of membership which is issued to each member. As this association has grown in its 15 years of existence, and now occupies a place in the railway world, when it is an honor to belong to it, it has been thought by some of our members that it would be well for the association to issue certificates of membership to its members. [Mr. Eck here displayed two drawings of certificates of membership, one being probably 15 in. x 20 in., and the other about 8 in. x 10 in.] The certificates would be issued to the members at cost. The plates for the certificates would cost in the neighborhood of $100, and copies of the certificate would be furnished at about $15 a hundred. I move that the executive committee be instructed to look into the matter and to procure such a plate, and provide for the issuing of such certificates to the members who desire them.

[There was considerable discussion relating to the details of the proposed certificate.]

Mr. Mock: I move that in the next journal issued the secretary of the association make a proper announcement of this matter, and that if more than 100 members reply that they desire to receive such a certificate of membership, he be authorized to issue to such members a certificate of membership for the sum of $1.

Motion carried.

A paper by H. M. Beck (Electric Storage Battery Co.) on the Portable Storage Battery in Automatic Block Signal Service was then presented:

Portable Storage Battery in Automatic Block Signal Service.

Portable storage batteries have now been used in automatic block signal service for a sufficiently long period and on a sufficiently large scale, so that data based on actual results is available, and it is the purpose of this paper to bring together such data in convenient form for reference.

The regular use of storage batteries in this service dates from 1899. The first cells contained plates of the stationary type, assembled in portable form. They were not altogether satisfactory on account of their weight, two cells mounted in a case weighing about 60 lbs., and on this account, a few years later, a limited number of cells containing pasted plates of the vehicle type, were put in service. A pasted cell of equal capacity is much cheaper, smaller, lighter and consequently more portable. These cells known as the "PV-5" were not the proper shape, their base being too small for their height, so that they were easily upset, and on this account a smaller plate approximately five inches square and known as the "SS" was adopted about 1904, and this plate is now the standard. The jars usually contain from seven to nine plates, according to the capacity required, and from four to six cells are commonly connected in series, depending upon the voltage of the signals. They are boxed in wooden carrying cases so that they are convenient for transportation.

The standard method of assembly is to have four cells, type "SS-9," contained in a single carrying case. Where it is desired to reduce the weight, two cells only are placed in a case. The early practice was to join the cells by some form of a clamp or bolt connector, so they could be easily taken apart, but experience has shown that with proper attention it is seldom necessary to take them apart, so that the solid burned connection is coming into use. This practice eliminates a number of connections which not only require considerable attention to keep them in good condition, but are also a possible source of failure. The end connection is brought down to a wing nut terminal by means of a flexible rubber covered cable. Thus the number of connections is reduced from eight to two.

The jars are set in compound. They are thus more uniformly supported, which means less breakage, and even should they break, the compound will tend to make the leak a slow one and to protect the wood from the action of the acid. The compound is carried up over the tops of the cells, covering everything but the vent plugs, and thus forms an effective sealing and prevents leakage. Drainage holes are provided which carry off any electrolyte which may collect on top of the compound. The cylinder vents are unscrewed when it is desired to replace the evaporation or take specific gravity readings of the electrolyte.

For spacing the plates, wooden separators have been found to be very satisfactory and are standard in practically all cases. The wooden case is supplied with a cover for keeping out the dirt and the bottom contains an expansion joint, the purpose of which is to prevent the sides from being forced out, should the wood become acid soaked.

The number of cells in a set will depend upon the voltage of the signals and the speed at which it is desired to have them operate. It is usual to figure on two volts per cell, so that on this basis four cells would be required for an eight-volt signal. One large road is using four cells in connection with 10-volt signals, and reports that the duration of an operation is about 10 seconds as against seven seconds, when 16 primary cells are used. This refers to intermittent work, as where a number of operations follow each other in rapid succession, the storage battery gives the greater speed, due to its low internal resistance and high capacity. For equal speed on intermittent work, five cells of storage battery give about the same speed as 16 primary cells.

The size of the cells or their ampere-hour capacity will

depend upon the number of signal operations and the length of time during which it is desired to have the battery operate without charging. At least one-third reserve capacity should be allowed for irregularities, or in case the battery is not changed promptly. It is usual to have a battery operate a signal for one month and then replace it, this period having been selected as the maximum during which it is safe to allow a battery to continue without charge. There are indications, however, that where it is of advantage and the capacity required is not too great, cells may be left out for periods of two months, and if properly charged, can be kept in good condition. Some experiments in this direction are now being made. On the other hand, it will probably be found that, where the number of operations is so great that the cells have to be regularly changed more frequently than once in three weeks, the case is not a portable battery situation. The number of operations which a given type of cell will give, has not been accurately determined, but in one case an "SS-9" was left out for three months without trouble, this corresponding to some 3,000 operations.

The number of sets of batteries required will depend upon a number of conditions and will have to be figured out for each particular case, as nothing more than the most general figures can be given. Due to the fact that a certain number of batteries will be required for charging while the rest are in use at the signals, there will always be a greater number of batteries than the number of battery locations. Some reserve sets will also be needed for overhauling and emergencies. Data obtained from several railways indicates that the total number of extra sets required will be from 20 to 35 per cent. of the actual number of battery locations.

Due to its high capacity and low internal resistance, it is practical to operate more than one signal from the same storage battery. One large railway has decided that it is economy to operate signals within 500 ft. of each other from one battery. The number of battery locations as compared with the number of signal locations will vary in different cases as the number of signals which can be operated from a single battery, will depend on their relative locations. Actual data obtained in one case shows the total number of batteries to be 86 per cent. of the number of signal locations and 78 per cent. of the total number of signal blades. In another the figures are 87 per cent. and 83 per cent., respectively.

Where portable storage batteries are used, facilities must be provided for charging. A separate building is not always necessary, as it is often possible to use part of a building required for other purposes, the space actually needed for charging the cells not being very great. For example, in one case where 225 sets of batteries are handled, the actual charging space is only about eight by 12 ft. Where storage batteries are not used it is still necessary to have some sort of a building for a store room, work shop, etc., and it has frequently been practical to use part of this or make a small addition to it. It is preferable to locate the charging plant at some place where reliable power can be purchased, rather than to attempt to install a generating outfit, as power can usually be purchased for less than it can be made. Small charging plants are apt to be unreliable and require a large percentage of the battery man's time to keep them running. It is also of considerable advantage to be able to charge over night, which is hardly practical in connection with small generating plants, as these need some one present to look after them. Lighting companies will generally give a very favorable rate on current for charging storage batteries on account of the character of the load. Figures obtained in widely different sections of the country show that such power can be purchased at from three to eight cents per kilowatt-hour. If the power is alternating, a rectifier will be required, otherwise suitable resistances. In either case the switchboard should include one voltmeter, an ammeter which can be connected in each circuit, if there is more than one, and for each circuit, a rheostat, an underload circuit-breaker and the necessary switches and fuses. The rheostat should be capable of cutting down the voltage if necessary, so that it is practical to charge as few as three or four sets in series. The usual practice is to charge from six to 10 sets in series, depending upon the number of cells per set. Forty individual cells can be charged from a 110-volt circuit. The number of circuits required will depend on the number of sets to be charged at any one time. The cost of a rectifier or direct-current switchboard, while considerable in itself, does not amount to very much when divided among the two or three hundred sets of cells which it is capable of handling.

Where it is necessary to install a charging plant, from two to three kilowatt capacity will usually be required.

With the storage battery system a special battery man is required to look after the charging of the storage batteries, etc., for each section of from 100 to 150 miles, but on the other hand, no other battery men are required and the maintainers not having to be battery men, are thus relieved of both responsibility and work, so that they can either cover more miles of track or else work in other directions. For example, it is the regular practice where the storage battery is in use, for the maintainers to look after the lamps and no special lamp men are required. Thus, while with the storage battery system, an extra man is required to look after the batteries, this is compensated for by the fact that less men are needed on the road. Actual figures as to the total amount of labor under the supervisor have been obtained in several instances where the storage battery is used, and these are quite uniform where the conditions are comparable, showing an average of one man per 10 miles of single track equipped with 20 signals. In considering these figures it should be borne in mind that they cover all labor, including foremen, repair men, lamp men, etc., and do not simply refer to the maintainers.

There are now a number of roads which have had portable storage batteries in use for five years or more and the results obtained under normal conditions, indicate that a depreciation of 20 per cent per year is, if anything, conservative. There have been some special conditions in the extreme South under abnormally high temperatures, where plates have had to be renewed after only two years, but this condition is a special one and steps are being taken to meet it. Elsewhere the positives are giving from four to six years, while the negatives give indications of lasting much longer. This life is, if anything, less than might be expected, as it corresponds to only some 60 discharges on the basis of 12 per year, whereas the same type of plates will give some 200 discharges in a vehicle or 300 to 400 discharges on a bench. The shorter life in signal service is probably due to the cells not having as careful handling, or else to the long time over which the discharge work is distributed. The wooden carrying cases require renewal every two or three years, but this is a comparatively small item, while the rubber jars, except where broken, should last indefinitely. Thus a maintenance charge of 20 per cent per year on the first cost of the battery would seem to be conservative.

Where power can be purchased the cost of current for charging is surprisingly low. For example, consider a set of five cells, type "SS-9." Eight such sets can be charged in series from a 110-volt circuit. The charging rate is eight amperes and an average length of charge is probably about 20 hours. This corresponds to a very low ampere-hour efficiency, only 40 per cent, but the efficiency in this service is low due to the infrequency of charging. At a price of six cents per kilowatt-hour, the cost of charging the set would be $0.132. Assuming 12 charges per year, this would amount to only $1.59 per set per year.

A number of different schemes are being employed in transporting the cells to and from the signals and it is, of course, evident that the best solution in any case will depend somewhat on the local conditions. On one point, however, all seem to agree, namely, that the batteries should always be accompanied by an attendant in order to avoid damage in transit.

The most common method is to slip the cells to and from the maintainer's location on local freight or passenger trains, and the maintainers then distribute them to the signals on gasoline cars or velocipedes. Either the battery man or an attendant accompanies each shipment. A modification of this system is to have the maintainers bring the batteries to the charging station. This scheme is being used by a road where the distances are not great and the train service frequent. Still another modification is to send the batteries out on local freights with sufficient men so that they can be exchanged at the signals as they are passed, without stopping the train. Four men are needed. One jumps off the front of the train and disconnects the old battery from the signal. A few cars back two men get off with a charged battery which they put in place and return the discharged set to the train. The new battery is then connected up to the signal and the battery well closed before the rear of the train has come up.

A radically different scheme is being tried out by one of the western roads, and the signal engineer is said to be very enthusiastic over it. A box car has been fitted up with a portable charging plant and is moved from point to point, stopping at the various maintainer's locations and charging

the batteries. The crew consists of one man and as this car is able to cover 200 miles of track per month, it not only takes care of the transportation problem, but since two stationary plants would be required to handle the same territory, it cuts the number of charging plants and battery men in two.

The Missouri Pacific has had a system in operation for a number of years which has given excellent results. The territory covered roughly forms a "Y" with St. Louis at the base. The battery house is located in the yards at St. Louis, current being supplied directly from the company shops. There is one battery man who takes entire care of the cells, charging, overhauling and delivering them to the maintainers at the local stations. Twice a week on Tuesdays and Fridays, he goes out with charged batteries and delivers them at the local stations as previously requested by the maintainers. The batteries are then distributed to the signals by the maintainers on velocipedes, the discharged batteries being left at the most convenient station to be picked up by the battery man on his return. These trips require one day each. On the two intervening days the batteries are charged and overhauled. The train on which the batteries are shipped is in the yards over night and the batteries are loaded into the baggage car late in the afternoon or evening and go out the next morning. On the longest trip 30 sets of cells are taken out and the cells are delivered as far as Bismarck, a distance of 79 miles. Batteries are required some twenty miles beyond this, but are carried on by relay, it not being practical for the battery man to go further and return to St. Louis the same night. With this system one man takes care of 225 sets of batteries, 36 of which constitute a reserve for repairs and charging.

As will be seen, the Missouri Pacific system combines a number of very excellent features. Power is furnished day and night so that the battery man is not only relieved of all responsibility in operating the generating plant, and thus has more time for the batteries, but the charge can go on through the night when he is absent, which results in a very considerable saving of time. Since the batteries are always under his supervision until delivered at the way stations, the likelihood of their being damaged is lessened.

The radius covered, 79 miles, also indicates that this system ought to be quite generally applicable, as with charging stations only needed every 150 miles, it would seem like an exceptional case where reliable power could not be obtained within these limits, either from a public lighting or traction company or from a plant run in connection with some railway pumping station or shops.

The effect of the use of portable storage batteries on the reliability of a signal system is a very difficult thing to determine. One of the largest users states that while their experience has been that there is also an economy, still their policy is entirely determined by the question of reliability and that the net result of the use of the storage battery is a lessened number of signal failures.

From a theoretical standpoint it seems as if there should be a tendency towards greater reliability. The more units there are in a battery, the more chance of trouble both in the cells themselves and in the connections, as anything wrong with any one of them will interfere with all. The storage battery certainly reduces the number of units to a minimum. The maintainers do not have to be battery men, all that is required of them being to change the batteries at regular intervals. Battery knowledge is concentrated in one man who can be a specialist, and the batteries should thus receive better average attention.

While at the higher rates of discharge their capacity is reduced at low temperatures, the temperature coefficient falls quite rapidly as the rates of discharge decrease, or what amounts to practically the same thing, the length of time during which the discharge takes place, increases. Thus while at an eight-hour discharge rate the capacity decreases approximately one-half per cent per degree Fahrenheit, at one-tenth of the eight-hour rate the coefficient is only 0.15 per degree Fahrenheit, or, in other words, the reduction in capacity is almost negligible.

The electrolyte is practically immune from freezing, so that no special precautions have to be taken in this direction.

The internal resistance of a storage battery is so low that where special conditions occur signal operations may follow each other with great rapidity, or even simultaneously, without danger of failure. The internal resistance of the "SS-7" cell runs from approximately .006 ohm at a temperature of 80 degrees to .012 ohm at a temperature of 20 degrees Fahrenheit, and thus is almost a negligible quantity.

From the standpoint of economy also the storage battery would seem to be an excellent proposition. The initial cost of the cells can easily be obtained from the makers and with the data here given, both the approximate total first cost and maintenance expense for a given case can be quite easily worked out and it is believed that many cases will be found where a marked saving could be made.

In closing there are only one or two points which should not be overlooked. First, portable storage batteries have now been used in signal service on a considerable scale for some ten years, so they can no longer be considered as an experiment. Second, in the last ten years, conditions have changed very materially in regard to the possibility of purchasing reliable power for charging. Small towns all over the country now have their own lighting plants, electric railways are springing up everywhere, and thus the problem of charging has been greatly simplified, so that while the portable storage battery has its limitations, it certainly seems well worthy of serious investigation in many cases where it is not now being considered.

Mr. Eck: Why should the charging rate in amperes in portable storage batteries be given as a ten-hour rate, instead of an eight-hour, as usually given for storage batteries?

Mr. Beck: There are two general reasons. In the first place, the paste cell is weaker than the standard type, and in order to save it we like to have the charging rates as low as we can get them. The other reason is that the paste cell is apt to be rated at a capacity which will not give its full capacity at the service rate.

Mr. Eck: Would it be practicable in this style of plate to charge the cells at a high rate, and then taper off the charge toward the end of the charge? For instance, double the eight-hour rate at the beginning and taper off the rate at the end?

Mr. Beck: That would be all right, but it would not be practicable if the rate is reduced by the time the gassing begins. The injury is done almost entirely during the latter part of the charge, when the cells are gassing. If you can find the high rate at the early part of the charge that would be all right.

Frank Rhea (General Electric Co.): If you charge even a slower rate than ten hours, would it be still better at the end of the charge?

Mr. Beck: Yes, if you have time. If the rates get too low, however, it is difficult to determine when the battery is charging, and you do not want to get them so low that you do not get the charging indications, but that is the only limitation.

Mr. Stevens: As to the use of a primary battery, or a storage battery, I have analyzed the situation somewhat in this way. We put up a primary battery and it runs for a year. There is no labor done on the battery for a year. If we installed storage batteries we have to do some labor on them every month, collect them, take them into the shops, charge them and redistribute them. It has occurred to me that something that we can put down and leave for a year is better than something we have to expend labor on every month or every three months.

Mr. Beck: As Mr. Stevens says, there is a certain amount of labor connected with the distribution of storage batteries every month which we do not have with the other type. We have collected figures on roads using storage batteries and also figures on roads using primary batteries, but as far as we can find out the labor question does not seem to be affected either way. This would indicate that the labor of distributing storage batteries is made up in other ways on the roads using primary batteries. That is not a question of theory but one of fact.

If you assume the labor is not increased and that the reliability is the same, then the next point of importance is the cost. Of course, that has to be figured out for each individual case, but in many cases the figures show that a distinct saving can be made by the use of the storage battery. This might not be true in other cases, as it depends on special conditions.

Mr. Rhea: Do you consider it advisable to charge a large number of sets in series, or a comparatively low number and increase the number of circuits? You state that there should be a rheostat and underload circuit breaker and the necessary switches and fuses. In addition to that is it necessary between the different circuits, when you have more than two, to have a reverse current relay, in case anything happens with the source of power to cause an unbalancing between the two sets or four sets?

Mr. Beck: It is necessary to have some such protection, but the underload circuit breaker, which I have specified, takes care of it. If the current drops to zero, the circuit is cut out. I should say, in general, the fewer circuits you have

the better, from the standpoint of attention in the way of requiring adjusting current, etc., so that the more you can charge in series, the better from that standpoint.

Mr. Elliott: Being an advocate of the charging of storage batteries by line, I should like to point out the advantages we have by such a system. Transferring portable storage batteries to the nearest station for recharging, and returning the batteries to the signal location on a velocipede car is prohibited on many roads, either on account of the frequent train service, unfavorable grades or weather conditions. In figuring the cost of portable storage batteries the paper does not seem to take into consideration the time of the men required to distribute the batteries, time which is not required with the present system, nor is the expense of transportation of the batteries by train figured. I understand that on the roads where the portable storage batteries are used the flooring and floor beams of the cars transporting these cells are very much injured and have to be renewed with considerable frequency. The consumption of current in the places where this type of cell is used must be very small. We are using on the Niagara Falls branch 120 ampere-hour batteries, and the charging requires an average of twenty hours a week. This discharge with the train on the track circuit is an ampere, and, figuring on the basis of .3 of an ampere consumption of current, or 8.2 ampere hours per day, that 120-ampere-hour cell would have a life of 15 days. It is stated in the paper that where the cells have to be renewed oftener than once in three weeks, it is not a portable storage battery situation, and as we charge all of our batteries approximately 18 to 20 hours a week, it would seem that few of our installations would be properly supplied or could use portable storage batteries properly. There is another matter—the life of the cells. The paper states that the maintenance charge is 20 per cent per year on the first cost of the battery, that is, that the life of the cell would be approximately five years. On the installation I have mentioned we have batteries that have been in use five years and seem to be in as good condition today as when they were put in service. There has been very little material that has disintegrated and dropped to the bottom of the cell. There is an undoubted advantage in the life of cells in generating current at local power stations along the line, or else purchasing it and distributing by a power line, and charging the batteries in place.

Mr. Beck: I certainly do not wish to advocate the portable storage battery for cases where the traffic was so heavy, and that I brought out in my paper, although I did not mention the line charging method as the solution of the problem in that case. Where the traffic gets so heavy, I think you will find the limit I give restricts you to the point where you must have the line-charging method, where we would recommend the line-charging method as the proper solution. I think you will find the portable storage battery, on the other side of the line, is cheaper on account of saving the line charging. Where the portable cell has sufficient capacity, it is the cheaper proposition. The point that has been brought up as to the possibility of using velocipedes was one criticism that Mr. Mann made of this paper, in stating that he thought that was the limit of possibility of using the portable cell, rather than the capacity. Where the traffic is so frequent that you cannot use the velocipede, you cannot use the portable system, that should be the test, but I think it works out at about the same point, if you compare it with the number of train operations given, it figures out for "SS 9" something like 3,000 operations; that will be equivalent in three weeks to about an average of about 120 movements a day, as the limit of the portable battery situation in that case. As to the weight of the cells, I think the statement of 123 lbs. is a little high. The "4-SS 9" weighs 58¾ lbs., and the "4-SS 7," which is the most largely used battery, weighs 45.5 lbs. a set. The cost of transportation I have not figured in, because in the case of every road that is using them there is no charge for transportation, the batteries being carried free just as other freight is. But as a matter of interest I have figured out about what it would cost to transport the battery for a year on the rates given by one of the eastern roads. The freight rate is 14 cents per 100 lbs. per 100 miles, or less, which I understand is a fairly high rate, if anything, and on that basis the "4-SS 7" set, with 12 trips a year, would cost $1.60 a year. On the basis of the rate that has been given by one of the western roads, ½ cent. per ton mile, it figures out at 9 cents per year, so in either case there is considerable leeway. Where it is a portable battery situation, you can charge transportation, if you wish to, and still show a material saving. The question of the injury to the baggage car was new to me and I have not heard of a complaint of that kind.

Mr. Young: Some time ago we experimented on our road with portable batteries in place of the primary batteries. We found that the 5-cell box was too heavy to handle. We have gone to the 2-cell and 3-cell box; a man has no trouble in carrying them out and taking one in each hand. They last month with one charge. It costs 20 cents a signal, against 60 cents and 75 cents with a primary battery. I figure that in about eight or ten months a battery pays for itself.

H. B. Mann: I asked Mr. Young how many trains he has a day in his territory, as that seems to be an important feature. Mr. Young says: "Parts of the day our trains are three minutes apart."

Mr. Stevens: That is a line-charging proposition.

Mr. Eck: I want to emphasize Mr. Beck's point in regard to purchasing current instead of developing it in your own plant. That point should be considered seriously in any proposition. If we could find out what it is costing us now in the ordinary gasoline generating plants, I think you will find it runs from 12 to 20 cents a K.W. hour, whereas you can buy the current from ½ cent to 8 or 10 cents a K.W. hour, besides having an unlimited supply and get rid of a lot of trouble. Within the last year we have displaced a number of isolated plants for lighting depots. In one case we showed a saving of over $4,500 on a small plant.

H. B. Mann: It seems to me the association, so far as the use of storage batteries on signals is concerned, owes a great deal to the California companies. In 1890 experts went to California and one of their particular duties was to show to the people that electro-pneumatic valves, as built in the east for storage batteries, were better than gravity cells. After they got to California, they found the people had been using storage batteries for two or three years. The paper shows that in 1899 they began to use storage battery cells on pneumatic circuits. The association should bear in mind the pioneers in storage batteries, both fixed and portable, are in the California territory. Mr. Slater should be given credit for a good deal of this work. It is unfortunate that some of our members from California are not here to speak on this subject.

Mr. Peck: We are using the storage battery on the Union Pacific, but I cannot tell you much about the details. They have been in use for about four years, and we are having very good success with them. As Mr. Elliott says, it is cheaper to have a charging line, but he is talking of a railway with four tracks. We have only one track, and that makes a difference. We have tried out some primary batteries on eight or ten different locations, but I cannot give you the details of the experiment. Mr. McKeen should be able to tell you a few things about this.

A. H. McKeen (O. R. R. &): We started about 15 years ago on the Southern Pacific to use a portable cell. We used at that time the "River and Rail" and they were quite successful. We never did much with the primary battery, but always used the storage battery. As you know, most of our lines are single track. We use the "SS 7" cell, which is mentioned in the paper. We have various means of charging these. At some locations we charge them with a rectifier where we can obtain the current, and in other cases we charge them with a gas engine-generator outfit. We also have several ways of distributing the cells. Where we have good local train service we distribute them on the passenger trains, leaving the cells at various stations along the line with the maintainer to pack up and change, leaving the changed cells at the station for the man who distributes them to pick them up on the local train going back, this being similar to Mr. Mann's method on the Missouri Pacific. In other locations we have a charging line as mentioned in the paper, with a gas engine generator in the car, and we run this car on the way freight, stopping at alternate stations, where the batteries are changed by the man in charge of the car and the maintainer, and the discharged batteries are brought back to the car and charged up before the car leaves for the next station. In that way we cover a territory of about 160 miles a month, with one car, figuring about two charges a month. Our batteries are arranged for a 50-ampere hour. At the home signals at the switches we change the cells in the distant signals, after the cells have been in service 15 days, operating two signals, and we interchange them with the cells at the distant signal. Consequently, these cells work only one signal. In that way the cell will last 30 days with a good margin of safety. On our mountain district we change our cells by loading on the pilot of a helper engine. The engine starts at the top of the mountain and goes down with a load of batteries on the pilot of the engine,

and the engine is started down 30 minutes ahead of the time it would start for ordinary purposes, and it stops at each signal where the maintainer changes the batteries. The engine returns to the top of the mountain, where the charging station is located.

Mr. Elliott: What batteries are you using for the track?

Mr. McKeen: Gravity.

Mr. Elliott: So that you require the battery man to look after the gravity batteries, and the only saving in the portable storage batteries is in the signal battery?

Mr. McKeen: Our maintainer attends to everything in his district, and looks after all the work in connection with the signals on his district.

The Vice-President: The question of the weight of the batteries has been referred to by several of the speakers. The paper does not definitely bring out what is considered to be the maximum weight per unit of value that can practically be handled on a speeder. Mr. Young called attention to the fact that they had used a complete set in one case, and it was necessary to change it. I think it would be well to have Mr. Mann, Mr. McKeen and Mr. Young say what they feel the maximum weight should be. That will determine the time and the system which is advisable for a given location.

Mr. McKeen: I would say that we arrange ours in weights of approximately 56 lbs., and one maintainer does not seem to have much trouble in carrying two of the cases in each hand.

Mr. Mann: I would like to ask one question, on the matter of the reliability, what 15 years of experience has developed as to his instructions to amend on sections. He calls them maintainers or repair men. What are your instructions to the men on your storage batteries if they have been in thirty days' service, understanding that you expect as reliable service as anyone else?

Mr. McKeen: Our signal maintainers take a voltage reading of their storage batteries. Other than that they have nothing to do with the battery problem whatever. The station men have charge of the overhauling of the batteries, and in case they need attention they are the men that look after that part of it. He takes the voltage reading in order to be sure that he will not have a signal failure on account of the discharge of the battery, and I will say the number of signal failures in our batteries are less than one per cent. of the total failures.

B. H. Mann: The point I wanted to bring out was nearly answered as to whether that feature of the pumping signal blade is the reason you take that reading. Exhausting the battery at a higher rate of speed than normal, could you cover that case with a counter on the signal, or is it some storage battery defect?

Mr. McKeen: I don't recollect any such failure. I have never seen it on our lines. Our batteries are sufficient to last ordinarily 30 days. Of course, we have once in a while a fall down in batteries on account of the overdischarge, not giving the proper amount of charge. Such cases, however, are very rare.

B. H. Mann: What is the length of your territory?

Mr. McKeen: Twelve to fifteen miles, and as high as twenty miles where the track is straight and where it is possible to run a gasoline motor.

Mr. Elliott: How long would it take, as a rule, to get another set of batteries to work the signal?

Mr. McKeen: In such a case, take the center battery out of the distance, which, of course, would not cause a very bad interruption of the batteries. I might say that these cases are also very rare and the maintainer in such a case wires headquarters for a man to locate it.

The Vice-President: Mr. Young, can you say the weight of the cell which you believed to be too heavy?

Mr. Young: Five cells are too heavy for a man to handle.

The Vice-President: What was the total weight of those cells? Do you know?

Mr. Young: I don't know; the weight now would run 25 to 26 lbs.

The Secretary: I think you use the "SS-7."

Mr. Young: Yes.

The Secretary: The five cells in one case weigh 56½ lbs., depending somewhat on the assembling.

The Vice-President: I do not know whether we have anything on the weight or not. Mr. McKeen says three cells weigh about 56 lbs. He said a man could pick up two in one hand. Is that it? Down in Maine a man can't carry one in two hands. It may be a question of locality.

A paper on the "Generation, Control and Transmission of Alternating Current for Railway Signals," by Frank R. Rhea and E. E. Kimball, both of the General Electric Company, was read by Mr. Rhea.

The advantages of alternating current for track circuits have been more or less recognized for some time and papers have been read and publications issued outlining various systems of track circuits and details of A. C. signal apparatus, but the signal engineer is concerned with another problem, for, after he has his signal problem worked out satisfactorily, he has yet to obtain a reliable and constant supply of alternating current. As soon as he begins investigating alternating current generation and transmission, he finds that his direct current practice stands for little and that the laws governing alternating current are different from those govening direct current For this reason it has been thought advisable to present an analogy between direct and alternating current generation and describe briefly some of the ways that alternating current can be produced, controlled and transmitted for the operation of railway signals.

The authors gave the principles of the construction and operation of A. C. generators and other apparatus.

L. F. Howard (Union Switch & Signal Co.): Mr. Rhea spoke of the parallel operation of the A. C. generators at different stations. The A. C. generation and transmission of power for signal systems is going to be somewhat different from the generation and transmission of power for other systems. The typical power transmission system generates a large amount of power, steps up to high voltage, transmits to a considerable distance, steps down again, and then we have the distribution at the end of the line. The A. C. signaling system is fundamentally and from necessity a distributing system, and it is a transmission system in so far as it is made so. I agree with Mr. Rhea that it is possible to operate alternaters in parallel, especially with turbines and steam engines, but think that considerable difficulty would be experienced in running the alternaters in parallel with gas engines. Mr. Rhea has stated that the division of the load between the alternaters in parallel depends on the adjustment of the prime movers, and anyone who has had experience in adjusting gas engines can imagine what trouble would be experienced by two operators twenty to forty miles apart in adjusting their gas engine governors so as to obtain the proper distribution of load between their respective generators. If parallel operation is attempted it will probably mean that the generators and prime movers will all have to be designed and furnished by one concern for any given system, for in so much as the proper synchronizing of the apparatus depends not only on the speed and load characteristics of the generators, but on the transmission line stands and the nature of the load, the designer will have to know all of these and very unsatisfactory results would probably be obtained if one generator was bought from one manufacturer, another from another, and so on with the prime movers. The question of operation of the signal system as a whole may have even greater weight in determining this question of parallel operation than the design of the apparatus and transmission line. Mr. Rhea spoke of the wattless synchronizing current passing between the generators. It is true that this current, which circulates between the machines in a generating station over the connecting bus bars is in a sense wattless, but, nevertheless, energy is being expended in heating up the conductors and in pulling the machines into step. When the generators are located twenty to forty miles apart this synchronizing current has to be carried over the connecting transmission lines, and in order to get good synchronizing the impedence lines must be low. If you get a short circuit on the transmission lines, with the four stations mentioned by Mr. Rhea, out go 120 miles of signals. The first operator who tries to get in on the line will probably blow a circuit breaker when he tries to handle 120 miles of signals. The second, third and fourth operators will probably do the same thing in succession. Then they will all call up the central office, notifying them that there is trouble somewhere on the 120 miles of line. The question then arises if it would not be better to do away with the parallel operation, cutting the lines between stations, and then by dividing the feeders going east and west at the generating station, when trouble occurs on any section, the circuit breaker for that feeder alone goes out, and if it does not stay in when closed, the operator knows that the trouble is confined to that particular ten or twenty miles of line and can notify the central office at once to that effect. As to the voltage, the power to be transmitted is small, and I think the distances will also be small. It is merely a question of balancing up the cost of high voltage generator and switchboard apparatus, high voltage transformers, cut-outs and lightning arresters, which have no more scrap value than the low voltage apparatus, against the extra copper which would be put in the transmission lines and which may increase in value as time goes on.

From what Mr. Rhea says in connection with three-phase vs. single-phase, I judge that he is in favor of the former. Putting aside the matter of complexity which would come with the three-phase, he has neglected the fact that three transformers, or a three-phase transformer, with three corresponding cut outs and lightning arresters, would be necessary at each signal location. He speaks of the advantage, when using the three-phase, of being able to lose one phase and still operate the motor. I cannot conceive that the difference in operation between a single-phase and a three-phase single motor can be the reason of Mr. Rhea's favor to the three-phase system, and must conclude that the three phases are necessary to the operation of the track circuit system. If the three phases are necessary to the track circuit system, the loss of one phase would disable the track circuit system. Where, then, would be the advantage of the three-phase motor over the single-phase motor, when there is no track circuit to close the relay contacts controlling the motor?

Mr. Rhea: The intention of the paper was not to touch on the signal system proper, and the point that Mr. Howard brings up as to the signal circuits is largely dominated by the interconnection of the circuits. It is not necessary to use three-phase, or three transformers, or three-phase transformers. It is possible to break connections well balanced by two-phase or three-phase quarter connections, as it is termed. That will give two phases. However, if the method of signal system is involved in using the single-phase track circuits, it will involve an arrangement of common wires, which will lead to a practice which ought to be really adopted in all signals, a separation by common wires, in almost an ideal manner. It means additional common wire, to use line wire control, but it doesn't mean doubling the common wire. If wireless control is adopted, or, what is analagous in D. C. practice, the track circuit polarized, another phase of the signaling problem is brought up. The signal engineer is confronted in A. C. signalling with two problems; one is signaling and the other is transmission. The study which I have made of the subject has been rather on the signal circuits themselves, and although it is not easy to figure out the circuits that will be necessary to use three-phase transmission and single-phase arrangement of signals, it is entirely practicable to do so, in my opinion, and in doing it is necessary to put in a system of common wires, which ought to be done and which a good many of the railways are now doing for their D. C. work. It will force you to that improvement, which is a good thing in itself.

Mr. Stevens: What do you mean by putting in common wire?

Mr. Rhea: Mr. Shaver sent out a circular letter a short time ago, which is particularly pertinent, as to the practice of the different railways and signal companies in regard to their common return wire. Mr. Elliott has a specification that this common wire must be good for five miles. The wire, in this connection, could be arranged common between certain sectionalizing points and particularly in the neighborhood of interlockings, which would almost necessitate putting the interlocking on one common wire, automatic signals on one side on another common wire and automatic signals on the other side on another common wire, overlapping the three of them. There are a number of details of that kind that are strictly signalling questions which will reduce to a question of the survival of the fittest.

Mr. Howard: Do I understand that with your three-phase system you could lose one phase and still operate the circuits without interruption?

Mr. Rhea: Yes, you would lose a portion of the track circuits.

Mr. Howard: What is the advantage, then, of the three-phase induction motor?

Mr. Rhea: With the three-phase motor, one particular advantage is the clearing of the signaling system when an interruption has occurred. With the commutator motor you have a large excess of current to start the system when there has been an interruption, about 300 to 350 per cent. overload being possible. That limits the extent of the transmission system, that can be handled with that generating plant; whereas, with a quarter phase motor, you can start your signal system with about 20 per cene. overload for the entire system.

Mr. Howard: As I understand it, your remarks concerning the advantage of the three-phase induction motor, in being able to start with one phase disabled, would apply to induction motors in general and has no force in connection with the signaling system.

Mr. Rhea: It will keep some of the apparatus working, and keep the system balanced. The track circuits connected on the other phases, of course, will be out of operation. You can keep your A. C. track circuits working through interlockings, which is another advantage that can be taken of it.

Mr. Howard: Is your reference to 300 to 350 per cent. applied to the increase in current of the induction motor, and not to the increase of the normal current of the signaling system?

Mr. Rhea: Yes, the dominating feature of the transmission system will be to design it so the signal system will start when there is an interruption of current.

Mr. Howard: But of course, the increase in the total load of the transmission system, will not be increased from 200 to 300 per cent.? The motor itself is a comparatively small per cent. of the total load of the system.

Mr. Rhea: No, I don't agree with you.

Mr. Howard: In throwing in the switch, after the power has gone off, the increase of the current over the normal current, we find to be well within 100 per cent.

Mr. Rhea: I haven't found it so. I have found on the starting load that with any system I have been able to get information on, the starting load has been at least 200 per cent. more than the normal load. Even with single phase wireless controlled circuits, your starting phase is dominating.

S. P. Hull, (N. Y. C. & H. R): I am in harmony with most of the things he has said. On page 49, he says: "As seen above, the current required to operate single phase motors is excessive, and it is obvious that a greater difficulty will be experienced in obtaining a generator of sufficient capacity," etc. As a matter of fact, single phase motors are now available in which the starting current and starting retorts are no greater than the running current and retort. They take less in starting than the three-phase motors. So I take it he means that remark to apply to induction motors. Three-phase motors are larger in efficiency and have no contraction, such as centrifugal contact to start them, or teaser windings; so that with the single phase motors now available a system can be started or reached after the circuit breaker has been opened without as much current as would be required with the equal weight that waould be required with three-phase motors. He speaks of the single phase generators requiring more material, and so forth. That is true, but the generators are so small that it is an insignificant matter, and without very much excess, because you can provide single phase generators which will start the whole system without excessive drop. With regard to sectionalization, I believe it is desirable where possible to sectionalize at sub-stations, that is, to feed normally from one sub-station to another, so if a break occurs the part of the line isolated can be taken up by the adjacent sub-station rather than sectionalized between sub-stations, although it becomes expensive sometimes to do that, and it is a question if the additional expense is warraned.

Mr. Stevens: We are going into this matter, and I think it will be a success. We have ideal station conditions from the fact that we get our power from our own stations and don't have to employ labor to develope the power, but aside from that, the fact that we are going to get modern methods which will reduce our daily tasks seems to me to be a move in the right direction.

Mr. Elliott: I would like to get some information in regard to a point mentioned in the conclusion: "We venture the prediction that the use of A. C. current will be extended in future signal installations on account of its being the only absolutely effective means of eliminating foreign current troubles, and it is practical to so design and construct A. C. signal apparatus," etc. I have been up against the proposition of installing track circuits in a large terminal where there are a great number of double slip switches. These switches are so close together that it is almost impracticable to install installation joints to allow the use of what might be called two-rail track circuits. It is expected in the near future that electric traction will be installed for the movements of trains, and whether it will be D. C. or A. C. traction, we don't know. If D. C. propulsion is to be used, A. C. track circuits might readily be put in with a single rail type; but my understanding is that no satisfactory single track A. C. relay has been designed to work; that A. C. current has been used for propulsion, that is, irrespective of the cycles used for the track circuit, and we may be up against this proposition at any time almost any place, because double slip switches are very often used where it is difficult to install two rail track circuits. If the signal companies can help us out and explain how such circuits might be used we would be glad to have the information.

Mr. Rhea: I believe there is a number of representatives of the conduit manufacturers here. We have ventured an outline of what has seemed a new type of conduit construc-

tion, and I believe there is quite a problem in that connection to be worked out.

Harold K. Weld, (McRoy Clay Works): It seems as if the basis of the whole A. C. transmission system depends upon the integrity of the transmission line, and, therefore, it would seem that it is a very important matter that all steps be taken to make it absolutely reliable. If a street railway line is planned, it would seem that a first class power transmission line should be installed, or if it is desirable to put in a cable then, if possible, to eliminate the effects of inductive disturbances upon the telephone and telegraph lines, that will aid considerably to a great extent. If an underground system is planned, it would appear to me that it would not pay for a company to bury in the ground a cable which probably would have a value of $1 per foot, perhaps, with no possibility of taking it up. I believe Mr. Rhea agrees that the Pullian type of conduit would be the most desirable, and I believe type if the facts were known the Pullian type would be the only type employed. I know of conduits where the cost per duct foot was as low as 11.6 cents. This was laid under a 2-foot strip, and included the manhole. I think you could lay conduits in this manner for 10 to 14 cents per duct foot. I believe the figures are reliable. I give them to you for what they are worth.

Mr. Peabody: I would like to ask if it is possible to lay a single duct at any such cost?

Mr. Weld: In laying pipe clay conduits in South Halsted street, Chicago, about 103rd street. I don't mean to say that 11.6 cents is always reached in city work, but I have in my pocket a great deal of data, obtained from one of the largest pipe service corporations in this city, where the duct foot cost total, including manholes, averaged about 14 cents per duct foot, using pipe clay conduits, multiple pipe.

Mr. Elliott: Would you have to use practically lead covered cable?

Mr. Weld: Yes, certainly it would seem to me desirable to use lead and wood cable, although I am not certain what alkalis, or salts, get through. I am speaking more from the standpoint of a paper cable. There may be other people who know the effect of the salts that get through the road bed better than I do.

Mr. Peabody: The cost of laying ducts as given seems to me to be very low. We laid four ducts, and with the manholes each averaged perhaps 250 feet apart, or a little less; the cost was a little less than 80 cents a foot for the four ducts, the manholes and all complete. It was rather surprising when we made our estimates up and we found that wooden trunking, filled up trunking would cost us considerably more than the conduits laid in concrete permanent construction.

Mr. Elliott: The ducts that were installed in New York for the electric zone cost about $65,000. I think for three and one-half miles of ducts. Vitrified ducts were used, laid in layers of four splicing chambers. We found it impossible to pull the cable for more than 400 feet. When the apparatus was first installed two transformers were placed in the splicing chamber, and owing to water leaking in we had to go to the expense of putting boxes above the splicing chamber; so the expense of underground construction with A. C. work was very heavy.

The meeting then adjourned.

The executive committee announced in the Journal published previous to the convention that all the propositions submitted to letter ballot, at the annual meeting held in Louisville, Ky., have been adopted as recommended standards by this association, with the exeception of the report of Committee No. 1 on signaling practice, all, with the exception of the report of Committee No. 1, having received more than the required two-thirds affirmative vote.

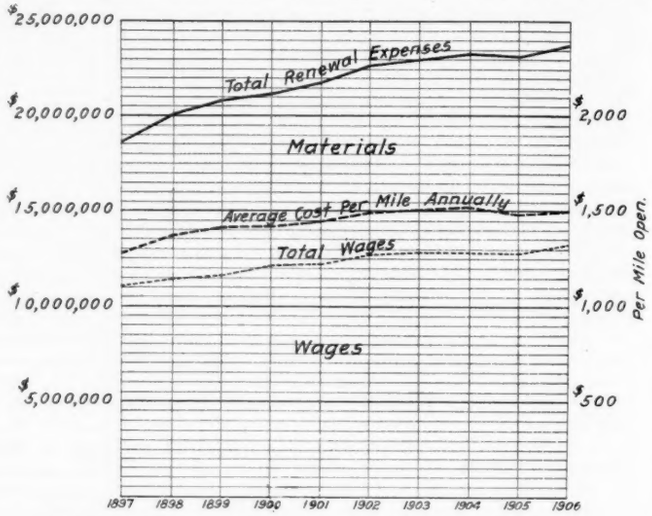
In the letter ballot on Wires and Cables, the item Specifications for Galvanized Iron Bond Wires was included in error. Also the definition of the word Mast, reading, "the upright to which the blade may be attached." should read, "the upright to which the signals are directly attached." By action of the executive committee, the first-mentioned was withdrawn after an examination of the minutes, which proved that it had been referred back to the committee instead of being submitted to letter ballot, and the latter was corrected as originally submitted.

Passenger charges on the Peking-Hankow railway in China are as follows: First class, 2.88 cents per mile; second class, 2.08 cents per mile, and third class, 0.76 cents per mile. Freight charges are as follows: First class, 13.28 cents per ton per mile; second class, 4.16 cents per ton per mile, and third class, 2.72 cents per ton per mile.

THE SERVICEABLE LIFE AND COST OF RENEWALS OF PERMANENT WAY OF BRITISH RAILWAYS.*

According to the Board of Trade railway returns (1907) there are, roundly speaking, a little over 23,000 miles of railway open for traffic in the United Kingdom, of which about 13,500 miles consist of double and more tracks, and about 10,250 miles of single tracks, besides which there are 14,000 miles of sidings. The total annual cost of the maintenance and renewal of way and structures amounted to roundly $55,000, nearly 15 per cent. of the entire working expenses, which have now and for some years past reached the exceptionally high figure of nearly two-thirds (63 per cent.) of the entire railway gross receipts.

In this paper the cost of the maintenance and renewals of the permanent way of fifteen of the principal British railways, having an aggregate of 15,184 miles of line (equivalent to about 80 per cent. of the total mileage of the railways in Great Britain), will alone be dealt with. The average cost of renewals per mile varies from an average maximum of £418.18 ($2,090) per mile during 10 years, in the case of the London, Brighton & South Coast to a



Permanent Way Renewals on 15 British Railways.

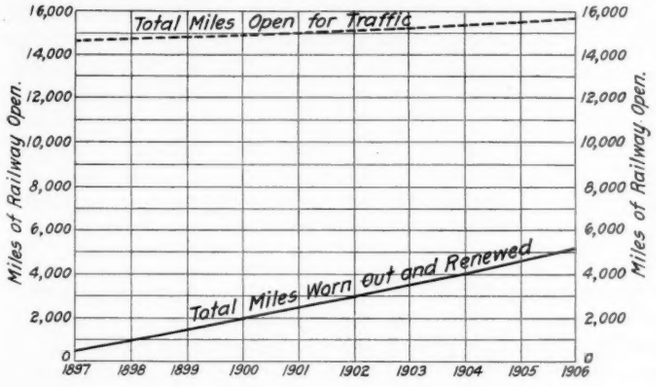
minimum of £190.80 ($955) per mile, in the case of the North British, while the tonnage of goods and minerals per mile in the latter case is just double that of the London, Brighton & South Coast. In another case, that of the Lancashire & Yorkshire, with a maximum tonnage of 41,678 tons per mile of goods and mineral traffic, the average annual cost of renewals is only £291.07 ($1,455) per mile, very little above the average. Again, in the case of the London & North-Western, with the large tonnage of goods and minerals of 26,493 tons per mile, the average cost of renewals is as much as £335.95 ($1,680) per mile, as compared with the North-Eastern company's average of only £236.26 ($1,180) per mile, with its heavy tonnage of 36,004 tons per mile of goods and minerals. It is clear, therefore, that we must look for something more than the mere weight of tonnage to account for the exceptionally large cost of renewals of the permanent way of some of the principal British railways, and there is everything to indicate that it is mainly due to the greatly increased weight and speed of the passenger traffic which has occurred since the introduction of the better and much more durable material of steel rails, and party to the increased weight and speed of the goods and mineral traffic. In this connection it will be as well to advert to the cost of the maintenance and renewal

*Abstract of a paper by R. Price Williams before the Iron and Steel Institute.

of the permanent way at the period almost immediately preceding the first introduction of Bessemer steel rails in the early sixties.

The total cost of the renewal of nine principal railways with iron rails during the 18½ years prior to 1865, with an average aggregate of 3,401 miles of line, during that period only amounted to £5,796,135 ($18,980,675)), and to an average of £170.40 ($850) per mile. It rapidly increased during the first 10 years, after the first partial introduction of steel rails, to £285.53 ($1,430) per mile, partly owing, no doubt, to the high price then of steel rails. Notwithstanding the great subsequent reduction in the price of steel rails to a lower figure than even the best iron rails, the expenditure on the renewal of way on these nine principal railways has, however, now reached an amount of £28,101,-881 ($140,509,405) and £314.66 ($1,575) per mile during the short space of the last 10 years—a fivefold increase in amount and now double the cost per mile in renewals—the mileage of these railways increasing from 3,401 to 8,930.

While the mileage during the last 47 years has only a little more than doubled, the operating expenses have increased nearly sixfold, the number of passengers carried has increased nearly sevenfold, the tonnage of goods and minerals carried has increased nearly fivefold, while the number of passenger and freight cars has only increased threefold; no doubt a considerable portion of the increase



Mileage Operated on 15 British Railways.

of the permanent way expenses is mainly due, as already stated, to the very large increase in the weight and speed of the passenger traffic, and partly to the very large increase in the tonnage of goods and mineral traffic, and also in some degree to its somewhat increased speed.

An intimate knowledge of the constituents of the material has been obtained by chemical analysis; but what are conspicuous by their absence in all these analyses are particulars of the physical qualities of the steel, and the amount of the tonnage and of the speed of the trains to which the rails have been subject, together with an exact measure of the wear of the rail-head during a given period.

Considered as way and structures and not merely as track, the average annual expenditure in maintenance and renewals of the permanent way, in terms per mile of railway, whether it consists of double or single lines, during a sufficiently long period of years, is in reality the real equivalent of the annual death-rate of all classes of the perishable materials which constitute the permanent way of any railway. By way of illustration a period of thirty years may be fixed as a sufficient interval of time to obtain average and reliable results of the destructive effects of the wear and tear of traffic, and of the natural decay and exceptional causes necessitating complete renewal of the materials of all kinds. As will be seen from reference to the accompanying charts, of the results obtained in the case of the 15 principal British railways during the last 10 years, means are afforded of determining very approximately the equivalent number of miles of way and structure of all descriptions which have become worn out and have been required to be renewed so as to have enabled the permanent way of the particular railway to have been maintained in a thorough condition of efficiency. All, in fact, that is required, with the data of the actual annual expenditure per mile of railway of these 15 railways during the past long period of years in question, taking 30 years as a definite and reasonable maximum limit of serviceable life of all classes of materials, subject to the destructive effects of wear and tear and of decay, is to multiply each year's annual cost of renewals per mile of railway by the past 30 years' fixed period, and to divide the total amount of renewals expenditure during the last 10 years by it, and we get the equivalent number of miles of railway—whether double lines or more, or partly double and single, or exclusively single lines, of each of the 15 railways. The results are shown in Fig. 2. In the aggregate this amounts in the 10 years to 5,039 miles of railway, or, roundly, 504 miles annually, which have become worn out and have been replaced in most, if not all, cases with stronger and better materials, and as the traffic on these railways is still rapidly increasing, it may be satisfactory to the steel-rail manufacturers to know that at least that quantity of worn-out steel rails will have to be simultaneously renewed during a similar period in the future.

SCHEME FOR CHICAGO UNION PASSENGER STATION.

In the booth of the C. F. Pease Company a blue print is being shown, a plan for a union passenger station in Chicago, which has been designed by Leroy L. Hunter of Chicago. Mr. Hunter's scheme is based on the theory that all existing passenger stations, except the La Salle street station, are to be abandoned; that Illinois Central suburban trains will continue to run to Randolph street; that the suburban trains of the North Western and the St. Paul will use the new North Western station; that all other suburban trains will use the La Salle street station; and that all through trains will use the proposed union station. Through trains of the Burlington, Great Western, North Western, St. Paul, Wisconsin Central and Southern Indiana would, according to this scheme, enter the new station via Sixteenth street; those of the Santa Fe, Alton and Illinois Central (C., M. & N.), from the west via Twenty-fifth street those of the Pennsylvania Lines, Rock Island, Pere Marquette, Chicago & Eastern Illinois, Monon, Grand Trunk and Wabash, from the south via Twenty-fifth street; and those of the Illinois Central, Big Four, Baltimore & Ohio, Michigan Central, C. C. & L., Lake Shore, Nickel Plate and the Chicago, Indiana & Southern, from the east via Twenty-first street tunnel. Mr. Hunter would have two depots, one for "inbound" and one for "outbound." Both would be situated east of Halsted and near Sixteenth streets, the "inbound" station between Clark street and Fifth avenue, and the "outbound" between Clark and State streets. Each depot would be 1,200 ft. x 666 ft. x 270 ft. high, and contain a grand waiting room with a 35-ft. ceiling, and an "upper" and "lower" waiting room above and below this main waiting room. Above the depots would rise buildings 15 stories high, containing space for the general offices of the railways. Each depot would have 28 tracks in the "upper" and 32 in the "lower" train room, maing 120 tracks in all and in both a total capacity of 360 trains per hour, or one train in and one out every ten seconds. The estimated total cost of the station and terminals would be $120,000,000. Mr. Hunter has worked his interesting scheme out in much detail, and has received several complimentary letters from railway officers to whom he has shown it.

Conventionalities

Alas, for fame! The sign painters insist upon calling the genial manager of the Pocket List of Railroad Officials, "J. Alexander Bron."

The Chicago, Rock Island & Pacific last week issued a revised code of rules to conform with the requirements of modern signal practice.

William V. Dee, the G. Drouve Company, was inquiring, "Seen John Reynolds or anybody like that around here?" Unfortunately, there is only one "like that."

E. G. Fisher, Railroad Fence Works and the American Steel & Wire Company have each set up a row of hurdles across their spaces at the Coliseum. It has not yet been announced when the race takes place.

"The man who whispers down a well
About the goods he has to sell
Won't reap the gleaming golden dollars,
Like one who climbs a tree and hollers."

A. R. Fugina, assistant engineer, signal department Chicago & Northwestern Railway, has been appointed office engineer. R. M. Phinney, chief draftsman, succeeds Mr. Fugina and H. O. Morgan succeeds Mr. Phinney.

The Signal Association ran special yesterday with a clear track and all arms at the proper angle in the upper quadrant. To-day one car runs as second section of No. 1, and may expect to find the boards against it occasionally.

The Atlantic Coast Line is installing a 40-lever, Saxby & Farmer mechanical interlocking plant at Fort Norfolk, Va., at the crossing of the N. & P. Belt. All signals on both roads give indications in the upper right-hand quadrant. No distant signals are used.

Who said "graft" or "undue influence" in connection with this convention? The committee of arrangements in the official program publishes a list of attractions at local playhouses, but calmly adds: "It is suggested that members communicate with the theater company direct for tickets." Chilly weather for March, isn't it?

The temperature of the interior of the Coliseum yesterday suggested the propriety of approaching the representatives of the American Valve & Meter Company to ask permission to build soft-coal fires in their row of cost-iron stoves, but hopes of warmth were rudely dashed when it was found that they were only the casings of the working parts of water columns.

Even so youthful a road and track supply man as John McKinnon remembers when the exhibit was not so large as now. He was one of the "Peripatets" who formed the principal part of the show a few years ago when the outfit was taken the rounds from Chicago to Detroit, Toronto and Portland, and he still insists that the exhibit of 1901 consisted of a soapbox full of Lufkin rules.

The usual labor difficulty cropped up yesterday morning at the Coliseum. A number of employes of supply concerns were helping install the exhibits and get the booths in shape. Union workmen, who were similarly employed, objected to anyone but members of their organizations doing such work. In order to prevent serious trouble the supply concerns consented to use only union labor and to pay the union men for the work that already had been done by the employes of the supply concern. These concessions and the good offices of the management of the Coliseum, smoothed matters over, and before evening everything—or almost everything—was lovely.

There seem to be about three things that Henry M. Sperry never misses. The first is, to know all about the new jobs of signal illustration—large jobs—that are to be done; the second, to know all the conditions surrounding the work and what the best signal engineers—the rest of them—think ought to be done under such conditions; the third, to get the jobs of supervising the actual work. Makes a pretty good job, too, when it's done. Nothing definite is known as to what he may have up his sleeve now, but he's here.

The regular meeting of the Western Railway Club will be held this (Tuesday) evening at 8 o'clock at the Auditorium. The subjects for discussion are: A report of a committee on Revision of the M. C. B. Rules of Interchange, and an address by Prof. H. Wade Hibbard of the department of mechanical engineering, University of Missouri, on "The Graphical Study of Information." As Professor Hibbard was, in the characteristic way, a pretty good Missourian even before he went to that state, it is supposed that the address will show much that he has been shown.

Walter F. Schleiter of Pittsburg, secretary of the Dilworth-Porter Company and president of the Railroad Supply Company, who, as president of the Road and Track Supply Association, deserves a goodly share of the credit for the success of the Railway Appliances Exhibit, is being congratulated by his friends on having had conferred on him the high honor of appointment by Secretary of State Knox as one of the delegates to represent the United States government at the International Railway Congress, which meets at Berne, Switzerland, in July. He was endorsed by many railway and railway supply men and also by numerous other prominent business men in his home city, Pittsburg, for this appointment.

A representative of one of the tie-preserving companies was observed wandering through the Coliseum yesterday humming half to himself what sounded like the air of a once-familiar hymn. The words were not caught distinctly, but seemed to be about as follows:

"Blest be-e soft ti-ies that rot,
The po-oles that soo-oon decay;
Just co-ome and se-ee the do-ope we've go-ot,
To ke-eep decay awa-ay.

"If woo-od would no-ot decay.
'Twould gi-ive us inwa-ard pain,
And we-e would ha-ave no chance to sa-ay:
'Our tre-eat; please to co-ome a-gain.'"

Local facilities do not permit us to reproduce the musical score, which is, however, well known. We have therefore endeavored to indicate the proper accentuation in type, omitting the third and fourth stanzas.

In making additions of new concrete to old structures an engineer suggests that it would be well to bear in mind the account of the Chinaman, Wu, who was set upon by robbers and had his head severed from his body with the exception of a narrow strip of skin. Being almost immediately discovered by his friends his head was carefully set in place and fixed with bandages. As the patient was strong and healthy the wound apparently healed and he went about his business with no apparent disadvantage save the presence of a thin, red line around his neck. But some months later Wu was sitting at a banquet when a really good story was told. Everybody laughed; Wu roared, threw back his head, when, lo, the seam opened and his head fell to the floor. It was impossible to repeat the previous first-aid operations. Wu was gathered

to his fathers and, on account of the Chinese veneration for ancestors it is stated that his heirs are still in litigation for damages from the heirs of the man who told the story. It is not clear whether the moral should be confined wholly to pointing out the danger of laughing uproariously in the vicinity of concrete structures, or whether it may not be extended so as to suggest an equivalent danger from laughing too heartily at funny stories told at a banquet.

MARGULIES' BAND.

Oscar Margulies and his band are giving concerts each afternoon and evening at the Coliseum. The programs for today are as follows:

AFTERNOON.

March—The Flag of Victory.....Von Blou
Overture—Semiramis .....Rossini
Waltz—Skaters .....Waldteufel
Put on Your Old Gray Bonnet.....Wenrick
Selection—Mignon .....Thomas
March of the Eagles.....Bratton
Ballet—Egyptiene .....Luigini
Intermezzo—"Curly" .....Powell
Cornet Solo.....Mr. Albert Wasshausen
My Pony Boy .....O'Donnell

EVENING.

March—La Reine de Saba.....Gounod
Overture—Stradella .....Flotow
Waltz—"Sweethearts" .....Sullivan
Hearts and Flowers.....Tobani
Selection—Little Nemo .....Herbert
By the Light of the Silvery Moon.....Edwards
A Hunting Scene (descriptive).....Buccalossi
Largo .....Haendel
Grand American Fantasia.....Tobani
March—Semper Fidalis .....Sousa

THE RAILWAY APPLIANCES EXHIBIT.

The Railway Appliances Exhibit at the Coliseum this year is substantially larger than was that of last year. The number of exhibits last year was 160. The number this year is 164. But a number of firms took more space this year. The total number of spaces taken this year is 224, as compared with 170 last year. The total space on the main floor of the Coliseum is 45,312 sq. ft. Of this 12,817 sq. ft. is used for aisles, and 32,517 sq. ft. for the exhibits. The space in the Annex is 6,138 sq. ft., so that about 38,000 sq. ft. is occupied by the exhibits.

Not only are the exhibits this year larger and more numerous than last year, but they are better. Last year's was the first exhibition ever given by the Road and Track Supply Association. The supply men have profited by their first experience in the Coliseum, and this year are splendidly utilizing its possibilities.

The hall is very tastefully decorated. Flags of all nations wave overhead, the American flag, of course, predominating. The balconies are decorated with red, white and blue bunting, and the booths in green and gold. The centerpiece of the hall is a resting place banked high with ferns and flowers, around the lower part of which comfortable benches are arranged. The walls are decorated with artificial flowers on wooden net.

The attendance at the exhibition on the first day greatly surpassed the attendance on the first day last year.

One of the attractions at the Coliseum is Oscar Margulies' band, which gives concerts every afternoon and evening.

The Coliseum opens every morning at 8 o'clock and closes every night at 10 during the convention and appliances exhibition.

ROAD AND TRACK SUPPLY MEETING.

The annual meeting of the Road and Track Supply Association for the election of officers and members of the executive committee will be held in the ballroom of the Coliseum Annex, Tuesday, March 15, at 3 o'clock p. m.

The secretary has issued a notice to the effect that while all supplymen attending the convention will be welcomed at to-day's meeting, only one duly accredited representative from each member of the association will be entitled to vote for candidates for office. The latter will be recognized by yellow badges; which badges may be had by applying to the secretary, John N. Reynolds, at the Coliseum, any time after nine o'clock this morning.

DINNER TO W. J. CALHOUN.

J. W. Duntley, president of the Duntley Manufacturing Company, makers of the Rockford car, and the board of directors and employes of this company, gave an informal dinner on the evening of March 8 at the Union League Club, Chicago, to William J. Calhoun, recently appointed United States minister to China. Sixty persons were present. Mr. Calhoun is one of the directors of the company. Mr. Duntley acted as toastmaster and in a short speech presented Mr. Calhoun with a watch fob set with Chinese jade. "May its mission ever be," said Mr. Duntley, "to recall to your mind this scene and the feeling that prompts us in presenting it, and serve to remind you that 'the distant far still to memory dear.'" In the course of his reply Mr. Calhoun said:

"When Mr. Duntley inaugurated this enterprise I do not think he had more than a half dozen men in his employ. The enterprise has since developed so rapidly that it commands the assistance of the large organization which is represented here to-night.

"Behind every manufacturing and commercial enterprise are several forces, particularly in the manufacture and sale of what may be called a specialty. In the first place, there is behind all the forces the inventor. His ingenious mind produces the article; he studies the need of the public, and he tries to invent and produce something to meet that demand, so that he is, after all, the beginner of every movement of this kind, and always the important element in its success. After he produces a thing that the public wants, then the next thing is to introduce it to the public. Now, this business, which has grown so rapidly that it has been a surprise to Mr. Duntley and everybody connected with it, is divided into two departments—first, the cleaner, with which perhaps most of you are identified. Sitting over there is Mr. Smith, whose brain conceived the machine in all its parts and prepared it for the use and application to the wants of men.

"Another important part of the business, and one which is destined in my judgment to grow greater and greater as the years go on, is Mr. Duntley's special form of handcar. And over there, on the other side of the table, is Mr. Westaway, who has worked for days and months and perhaps years, and finally realized all his dreams and aspirations, and who is at work producing something that bids fair to revolutionize certain elements in the transportation problem in this country.

"After the inventor is through with his work, the salesman is required to introduce it to the public. The inventor can do no good unless he is able to introduce it to the public, and the salesman is the man who goes out into the

field and carries the fruits of the inventor's mind. It takes no ordinary man to make a good salesman; he must first have confidence in the thing he is selling; secondly, he must understand its workings and its adaptation to the use for which it is intended, and he must be a good judge of human nature; for he must know how to approach people.

"You have in this enterprise inventors who, I think, are able to cope with anybody who comes into the field. You must have a general manager who has the ability to infuse life and vigor into the forces which he has at his control. I have known Mr. Duntley for some ten or twelve years, and if there is ever a man in this world who has faith in himself and faith in the business in which he is engaged, and the power to infuse energy and faith in those associated with him, it is 'Jack' Duntley, and one of the great elements of his success is his appreciation of good work.

"Jack says that he is going to send me reports every week, and if you get tired and break down I will come back, take off my coat, and help you all possible. In the language of the Duntley poet, whose lines I am now reading, when I come back I expect to find a Duntley cleaner in every home in the United States."

MR. HOOLEY ON ENGINEERS.

"I see be th' pa-apers," remarked Mr. Hooley yesterday morning, "that there's goin' to be a convintion av th' relrod engineers at th' Aujytoryum this week. Ye wud think, Dinnissey, that th' meetin' was that av th' min that run th' engines, wudn't ye, Dinnissey?"

"I wud," replied Mr. Dinnissey. "I wud so."

"Ye're arl wrong, Dinnissey. Th' min that run th' engines, they're enginemin. Iv ye heard about a convintion av enginemin ye cud go to ut, Dinnissey, but ye won't go. Ye'll niver hear av wan. There ain't anny such thing but the brotherhood, my frind. Th' min that run th' engines, Dinnissey, they might be engineers, but they a'n't. I niver saw wan that was. 'Tis a discombobylation av th' English language that putts th' min that runs th' engines in th' class wit' th' engineers. Th' engineers, thim's th' min that lay out th' thracks, an'——"

"I thought thim was Dagoes," said Mr. Dennissey. "Arl th' min that I've iver seen layin' down track 'nd shpikin' rails 'nd tamperin' wit' ties, they was arl Dagoes. Thim's engineers, d'ye say, Misther Hooley?"

"Av there was annything, Dinnissey, that ye cud undershtand as it is wudn't be so, ye're that wrong in ye'er comprihinsions," replied Mr. Hooley. "Whin I'm talkin' about th' engineers that's going' to have th' meetin' 'nd that's got th' whole av th' Collyseeum to show th' things they do their relrod business wit', I'm maning' th' aljaybry min—th' wans that figure out on pa-aper what th' min that handle th' dirt 've got to do. They make a pitcher av ut on pa-aper, Dinnissey, 'nd th' min that's got th' pick 'nd shovel 'nd that lays th' rails 've got to make th' job look like th' pitcher. Wanst me frind Jerry Sullivan was th' roadmaster on th' Union Passific whin Mr. Park, th' wan that they've just made vice-prisidint av th' Illinois Cinthral, was th' soop'rintindint av th' division where Jerry was workin'. 'Twas a grea-at job Jerry did in Whyoming. He cut down th' hills, 'nd tuk out th' crooks that th' engineers that built th' line putt in f'r that th' gov'mint was payin' f'r th' wurruk at so much a mile, 'nd the more miles the more pay 'nd the longer job th' more graft. They didn't know so will thin where th' hills was thut they cud dodge, ayther. Mr. Park he wanted to run more thrains and to have more yards at Larrimy, 'nd he says to Jerry, says he, 'Jerry,' says he, 'whin'll ye have thim tracks in at Larrimy?' 'T'ree weeks,' says Jerry. 'I want thim in in two,' says Mr. Park. 'I want thim in in two.' 'Will,' says Jerry, says he, 'iv ye'll take thim aljaybry min, Misthur Parks,' says Jerry, 'I'll have thim in in wan. I'll have thim in in wan,' says he. Jerry didn't till me whither they tuk off th' aljaybray min, but he did a good job, Jerry did, avin iv th' aljaybry min did bother 'im.

"Thim's th' min, too, Dinnissey, that makes th' tunnels fit th' mountains. They misure th' fut av th' mountain like th' shoemaker in th' owld counthry used to misure ye'er fut, whin ye was goin' to a dance 'nd had to put on boots 'cause they wudn't lit ye dance barefutted, 'nd thin they drill fr'm th' wan side to th' other undher th' middle av th' mountain, 'nd iv th' drill man kapes his drill sthraight th' drill fr'm th' wan side hits th' drill fr'm th' other side undher th' middle. Gin'rally, though they bores a hole down fr'm th' fr'm the top av th' mountain so't they can see th' drills whin they hit. They's wan tunnel that I saw in Colorady where they made a misthake in th' misurement. They made th' tunnel too long, Dinniessey, 'nd it shtuck out at both inds, 'nd it's a-shtickin' out iver since."

"What is ut that shticks out, Misther Hooley?" inquired Mr. Dennissey with some show of interest.

"Th' hole, Dinnissey," replied Mr. Hooley, "Ye c'n see ut at both Busk 'nd Ivanhoe. But th' hole looked so bad shtickin' out av th' mountain on both sides that they covered it up wit' snowshids. A hole a quarther av a mile long shtickin' out on th' livil ground wud look bad f'r th' engineers—th' aljaybry min—wudn't ut, Dinnissey? But they's wan pla-ace on th' Southern Passific where there's a hole thrutty miles long that don't go through th' mountain at all, at all. They didn't aim th' drills right at th' shtart, 'nd the hole runs along th' side av th' hills. They've covered that wit' snowshids, too, but in th' hot, dhry wither th' shids get on fire, 'and they're goin' to aim again 'nd run it through th' mountain f'r fear th' hole'll burn up, too."

"Th' aljaybry min make misthakes, thin?" inquired Mr. Dennissey.

"Sometimes, iv th' min that's doin' th' wurruk a'n't shmart enough to corrict thim or get th' min out th' way, as Jerry Sullivan thried to do on th' Union Passific. That's why they have these meetin's, Dinnissey. Wan man finds out what th' others have done in time not to do th' same thing himself. Iv it's a tunnel that's too long they c'n cover it up wit' snowshids, but iv it's a bridge that's too short they can't sthretch it more than up to th' 'lasthic limmut, 's they call ut, whin it breaks."

"I didn't know before what th' 'lasthic limmut av a bridge was," said Mr. Dennissey.

"Nayther did I," replied Mr. Hooley.

MANGANESE FROGS.

The Indianapolis Switch & Frog Company, Springfield, Ohio, is distributing passes, one of which is reproduced herewith, with the following announcement: "Enclosed we hand you pass over our line, which runs from Hicost-on-Maintenance to Economyville, via the Manganese Route, which is equipped throughout with I. S. & F. Co. Model R-N-R frogs, noiseless and easy riding. We will be glad to have you join us on an inspection trip March 14th to 19th, inclusive. The Convention Special will stop daily at Point Interest (Exhibit Space 182, Coliseum), where these frogs are installed. The reverse of the pass shows a floor plan of the Coliseum.

This is a solid manganese frog, requiring no renewals during the life of the manganese, and the track rails connect direct to the frog proper, with no alteration. Only one pair of splices are required, instead of four, and all rails are protected by manganese easers, so that it is claimed that all joint and point pounding is eliminated and that the frog is smooth riding, noiseless and lasting.

The company also makes a specialty of solid and insert manganese crossings and switch points, and all types of regular built-up construction.

At the Coliseum

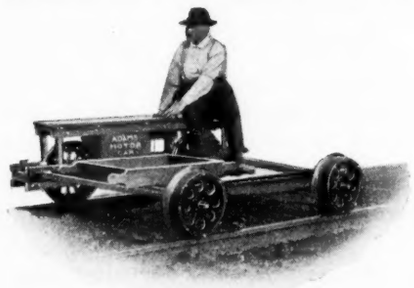
The triple lock switch stand, made by W. F. Bossert Manufacturing Company, Utica, N. Y., which is on exhibition in space 137, is attracting unusual attention from prominent maintenance of way and signal officers. It is evidently the long-desired device that locks switches and tracks in every operation. As a prominent officer remarked, "At last we have something that is proof against the carelessness of the operator. Now I can sleep at nights."

MALLEABLE IRON TRACK BRACES.

The National Malleable Castings Co., Chicago, has on exhibit in booth 145 at the Coliseum a number of malleable iron track braces, which are light, strong, well designed, and will withstand climatic conditions to a large extent. The exhibit is in charge of H. I. Hiatt and J. J. Byers.

ADAMS MOTOR CAR.

The Adams motor car is one of the exhibits in booths 113-114, by Burton W. Mudge & Co., Chicago. The car is very light, the four-wheel model shown in the cut weighing only 270 lbs., and is so well balanced that a signalman, lineman or lampman can easily handle it alone.



It is equipped with a two-cycle, three-port, air-cooled engine, controlled by a throttle lever, spark lever and compression relief lever for starting and coasting. The makers claim for the car, simplicity, durability, cleanliness, convenience, safety and economy.

ELECTRIC AUTOMATIC RAILROAD SAFETY SIGNAL COMPANY.

The Electric Automatic Railroad Safety Signal Company, 25 Broad street, New York city, is putting on the market the La Croix cab signal, automatic stop and train telephone, a system designed to work on both single and double track, and to provide means for communicating by telephone between a train on the road and the offices in the stations. This apparatus was exhibited to a large number of railway men on the Erie Railroad, near New York city, a few months since. The source of electric power for the necessary currents is a steam turbine carried on the engine, and the circuits are arranged to be normally closed. Contact is made with wires along the road by means of steel brushes fixed to the trucks of the tender of the locomotive. These brushes come in contact with an electrical conductor a few hundred feet long fixed beside the track at suitable intervals. This conductor is connected to a wire line on the telegraph poles along the right-of-way. The block signaling arrangements are such that when two trains, moving toward each other, come within the same block section, say within two miles, the resistance of the circuits on the engines is changed in such a way as to open a local circuit, and by suitable apparatus, to apply the brakes and also extinguish the green electric lamp which is arranged to glow at all times when the block ahead is clear. Simultaneously with the application of the air brakes, an air whistle is blown by the escaping air. A suitable recording device is provided, so that the exact time at which all operations took place can be known. The same wires that are used to connect the engine with the line for signaling are used also for communication by telephone. Thus the engineman can communicate with headquarters from any signaling point. As in all track circuit signaling, the apparatus gives notice when the electric current in the track fails by reason of a broken rail, and protection is provided against danger from cars on side tracks, fouling the main line.

SCHERZER ROLLING LIFT BRIDGE FOR THE GALVESTON CAUSEWAY.

The causeway now under construction across Galveston Bay, connecting the city of Galveston with the mainland, is to have a total length of 10,642 ft. The bridge proper is to consist of 28 concrete steel arches, each 70 ft. clear span, and a single leaf Scherzer rolling lift bridge, 124 ft. center to center of bearings, giving a clear channel for navigation 110 ft. wide. The piers to support the movable bridge are nearly completed and the entire work is expected to be completed early next year.

The Scherzer rolling lift bridge will be 45 ft. wide center to center of trusses, and will accommodate two railway tracks, one interurban railway track and highway traffic. Owing to the large amount of traffic to be accommodated, every precaution has been taken for the safe and rapid operation of the bridge. The movable span is to be operated by electric power, and under usual conditions will be operated within 30 seconds.

The movable span is a rigid structure, the counterweight being composed of plain concrete covered by steel plates directly fixed to the trusses. The new bridge is to be used by the Harriman Lines, Santa Fe, Missouri Pacific, Rock Island, Missouri, Kansas & Texas, Galveston-Houston Interurban Electric, and will also accommodate highway traffic to and from the Island.

The building of the bridge is under the charge of Linton W. Stubbs, supervising engineer. The design of the Scherzer rolling lift bridge was made by the Scherzer Rolling Lift Bridge Company, Monadnock building, Chicago, and the contract for the superstructure was taken by the Penn Bridge Company, Beaver Falls, Pa.

TEST OF DIAMOND TAPERED STEEL POLE.

The U. S. Metal & Manufacturing Company, New York, conducted a test on the Diamond tapered steel pole in the yards of the Chicago City Railway, Chicago, on March 12, the results of which should be of interest to many. The pole used was one of the standard Diamond poles for trolley, electric light, telegraph or telephone wires and the conditions of the test were intended to be as near as possible those met in actual service. The Diamond poles are made from two tapered plates, the longitudinal edges being flanged and each plate troughed, so that when they are forced together the pole has a square cross section, a uniform taper and diagonally opposite longitudinal joints. The pole used in this test was 30 ft. long, made of ¼ in. steel, was 8 in. square at the bottom and 4½ in. square at the top. It was set in 6 ft. of concrete and a force exerted horizontally at a point 18 in. from the top of the pole in such a manner that the line of strain was along the diagonal through the joints. Four loads were applied ranging from 500 lbs. to 2,000 lbs., and the following deflections were measured for each load: 500 lbs., 1¾ in., 1,000 lbs., 4 in., 1,500 lbs., 6 1-16

in., 2,000 lbs., 8⅞ in. After each load was removed the pole returned to its upright position and showed no signs of permanent deformation.

A pole on which a similar test was made by the Illinois Traction System at Decatur, Ill., is on exhibition in booth 18 at the Coliseum. This test is to be repeated one day during the convention week, as a number have expressed a desire to watch the performance of the pole. At that test, loads greater than 2,000 lbs. are to be applied to see what effect excessive stresses will have.

SWITCH AND SEMAPHORE LAMPS.

The Armspear Manufacturing Company, New York, is showing its heavy steel switch and semaphore lamps for one-day and long-time burners of standard design with the new side door, which is also this company's design. The feature of this new door is its being built with a real water shed, so arranged that water runs off of instead of into the lamp. It is air tight and the door stop is made integral with the door proper.

The new "Armspear" flat-frame long-time burner is also being exhibited. This burner has a removable cone, so that the parts are accessible for cleaning. It may be a combination or a non-chimney burner, as desired. The burner shaft is fitted with a drag to prevent the wick from jarring down. It is the purpose of the company to place this new burner on the market to meet the demand for a long-time burner of maximum candle power at a minimum consumption of oil.

The new "Armspear" bayonet catch outside adjustment steel lantern is also displayed. The oil pot is removed from the bottom instead of through the top, and it does not require the removal of the globe for lighting. In addition to the above new products a full line of "Armspear" switch and semaphore lamps, bridge and pier lamps, markers for classification and caboose cupolas, and straight body-type companion lamps are shown.

All top draft lamps are equipped with "Armspear," easy access top ventilation, the parts of which are in plain sight and easily removed for cleaning. Samples of all will gladly be sent to those interested. The exhibit is in space 184, to the left of the main entrance.

KING LAWSON DUMP CARS.

The King Lawson dump cars may now be purchased outright, which is a decided advantage over the old policy of merely leasing them. This arrangement has been made, it is said, on account of the increasing demand for these cars, which demand could not be met under the leasing plan.

This car is adapted to a very wide field of usefulness and its economy in operation is an important feature. The cars are standard gage, made of steel and equipped to meet M. C. B. requirements.

The King Lawson dump cars deposit their loads clear of the rails, which enables their use on main lines without interfering with the regular traffic. Rock can be handled with speed and facility, as can very large boulders and hot material in steel works. The simplicity and strength of this car's construction insures great length of service, the car being considered as good, from a practical standpoint, after five years of hard service, as when new. An important feature of the King Lawson dump cars is that they dump on either side and at a rate of 80,000 lbs. of material in one-half minute.

The King Lawson Car Company, 17 State street, New York, has illustrated literature regarding these cars, which it will be pleased to send to interested parties. This company also publishes some valuable information under the heading of "Construction and Improvement Information."

NEW TIE-TREATING PROCESS.

The Pacific Timber Preserving Company, Spokane, Wash., has just gone into the market with its tie-treating process, after four years of experiment and tests.

The process consists of dipping the ties in a hot solution of coal tar and other ingredients. This puts a coating on them that excludes moisture and protects the wood from the chemical action of the soil. The dipping process and the subsequent draining of the ties take but a few minutes, after which the ties are left for several days for the coating to harden. Ties which have been in actual service 4½ years in the tracks of the Walla Walla Traction Company are in a perfect state of preservation, while untreated ties of the same character, in the same track, laid at the same time, have completely rotted and been replaced.

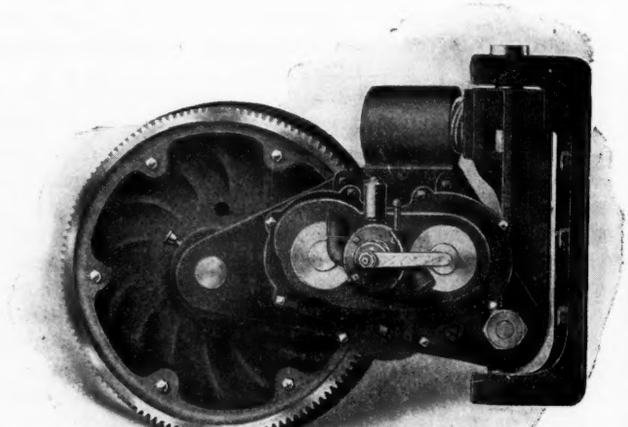
These ties have also been in service on the Oregon Railroad & Navigation for four years, without deterioration, and the Northern Pacific laid some last spring. Contracts have just been closed for supplying a minimum of 100,000 ties to the Northern Pacific, 25,000 to the Seattle Electric Company and 25,000 to the Washington Water Power Company, Spokane.

The process originated in a district where the life of untreated fir ties is very short, being from three to five years. The cost of the treatment is much less than that of creosoting, and the records of performance to date would indicate a large saving. A feature of the process is the fact that the treating plants are portable and can be set up at the points where ties are delivered to the railway, thereby saving cost of transportation to and from the plant, which means a great deal.

The treated ties are being exhibited in Space 11 at the Coliseum.

COMPRESSED AIR TURNTABLE TRACTOR.

Although the Weir & Craig Manufacturing Co., Chicago, (booth 143) has been well known for the past twenty-five years as a manufacturer of machinery, its entrance into the railway field dates only from 1907, when it took over the business and patents of J. L. Pilling Co., Chicago. Since this time, it has improved and added to its line of machinery, until now it has a complete line of compressed air and electric portable hoists, pneumatic and hydraulic locomotive drop pit jacks, combined electric tractors and winches for moving dead locomotives on to or off of the table, and machinery for operating transfer tables.



Compressed Air Turntable Tractor.

The illustration shown herewith is of the latest type of

compressed air turntable tractor which, as indicated by the number in use, is the most popular type. This is probably due to the fact that the machine can be operated either from a central source of air supply or from the locomotive which makes its application possible at any point.

A feature of this machine which is common to all the Weir & Craig tractors is the patented universal bracket. Being pivoted both horizontally and vertically it permits the tractor wheel to follow all variations in the pit rail, thereby considerably reducing the cost of maintenance of the pit rail, as well as greatly facilitating operation.

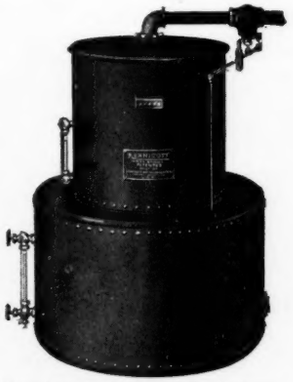
STRAUSS TRUNION BRIDGES IN EUROPE.

The Strauss Bascule & Concrete Bridge Co., Chicago, is making a number of very interesting designs at the present time. Among these is the bascule span which will form a part of the so-called Palace bridge at St. Petersburg, Russia. This structure forms the approach to the winter palace of the Czar and will be one of the most magnificent of continental bridges. In point of size and importance, it will surpass the famous Tower bridge of London, which still holds the record as the largest and most heavily trafficked highway bascule bridge in the world and which is also of the trunion type. The Strauss design was also selected for the recently completed Knippels bridge at Copenhagen, an equally noteworthy structure. The Strauss company has on exhibition in booth 157 a number of drawings and models of these bridges.

KENNICOTT WATER WEIGHER.

The Kennicott Water Softener Co., Chicago Hights, Ill., build an accurate water weigher which is well adapted for weighing water to locomotive tenders or for continuously weighing boiler feed water to stationary boilers.

This weigher, shown in the accompanying cut, is adapted to receive water from standpipe or tank and deliver it in unit charges of definite uniform weight to the tender. A counter registers each unit charge delivered and in this way an accurate check is kept upon the amount of water used, which gives at once the steam consumption of the



Kennicott Water Weigher.

locomotive. When the coal is also weighed the Kennicott water weigher furnishes a reliable means for checking the evaporative value of the fuel. The Kennicott water weigher is also adapted to weighing the water delivered to standpipes and storage tanks, and will weigh hot or cold water. It is simple, dependable, positive in operation, accurate at all rates of flow and entirely automatic. It has no valves, no revolving disks or vanes, and no pistons. Its accuracy is unaffected by changes of temperature or dirt, scale, sediment, rags, or sudden changes in rate of supply.

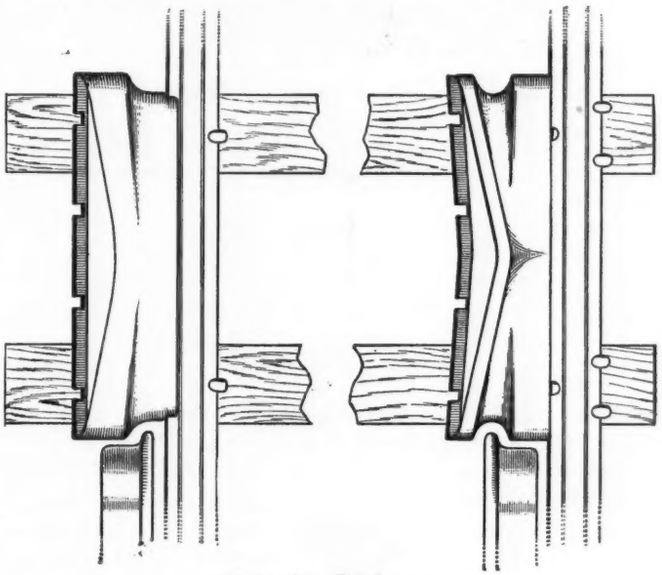
Each Kennicott weigher is assembled at the factory and tested and calibrated. The unit charge is accurately determined by actual weighing on platform scales; and a certificate of accuracy and capacity accompanies each shipment. The weigher is guaranteed to record the correct weight of water to within one-half of one per cent. of absolute accuracy.

The Kennicott Co. has an exhibit in booth 74 at the Coliseum.

BUDA CAR REPLACERS.

The accompanying illustration shows the Buda Company's No. 4 car replacer, which is being shown in booths 87-90 at the Coliseum. This replacer is for an 80 to 100 lb. rail, the weight per pair being 180 lbs.

Buda replacers are so designed that the tread of the wheel rather than the flange first comes in contact with the replacer which eliminates spinning of the wheel. In replacing a car the tread first engages the replacer, then the tread and flange, and finally the flange. The rise is gradual, which



Buda Car Replacer.

prevents any damage to the flange or replacer, and there is no jarring or jolting which avoids damage to the car.

These replacers are furnished in five different sizes for rails weighing from 60 lbs. up to 100 lbs. the replacers varying in weight from 197 to 240 lbs. per pair.

This company also make a single end type replacer for rails weighing 80 to 100 lbs. the replacer weighing 150 lbs. per pair.

GASOLINE MOTOR CARS.

For several years gasoline motor cars have been used for inspection purposes by men in signal, road and other departments; but it is only recently that they have been adopted as a practical car for regular section work, in place of the old style hand car. Motor cars as used in section work save the energy of the men for work on the track; they save the time consumed in getting to work and they increase the length of sections, with a corresponding decrease in the number of foremen. The possible increase in section length is variable, but if it is taken as one mile, a division with 40 four-mile sections, reduced to 32 five-mile sections, will show a yearly saving of about $4,800 in wages of foreman.

Fairbanks, Morse & Co. have recently added a new type of motor car to their line, which is known as style 27 and is specially designed for use as a section car. The engine is

two-cylinder, two-cycle air cooled, direct connected to rear axle, with enclosed dust proof crank case. The engine has no valves, cams, pawls, sprockets, or chains. There is no lubricating system, this being taken care of by mixing oil with the gasoline. Although very substantially constructed, and having a capacity for ten or twelve men, the car is but little heavier than a hand car; and it can easily and quickly be removed from the track. The speed is variable, from

Fairbanks-Morse Gasoline Motor Section Car.

6 or 8 miles per hour up to 30 miles an hour, which is perfectly safe, as the car is equipped with 17-in. wheels, and sets low on the rails.

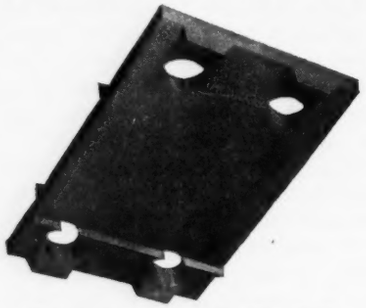
To provide for occasional engine failures, the car is furnished with a walking beam of the same type as on the standard hand car, which can be used by throwing a slip pinion on the front axle into a driving gear.

SCREW TIE PLATES.

The Spencer Otis Co., Chicago, has on exhibition in booth 122-141 many advanced types of economy tie plates, prominent among which is the Economy No. 9-R, designed especially for use with screw spikes.

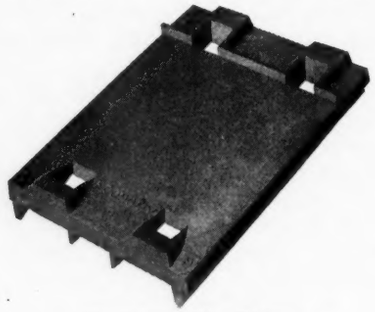
Rail Mounted on Tie Plate.

The introduction of screw spikes by steam, elevated and electric railways prompted the design of a tie plate, which



Economy Tie Plate No. 9 R.

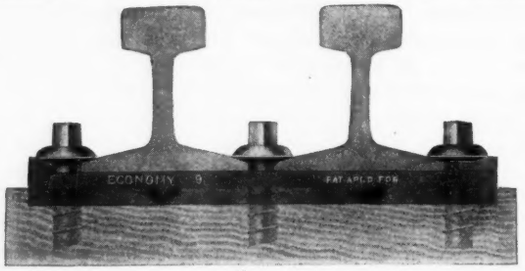
would furnish a perfect bearing for the flange of the spike on both rail and plate; furnish reinforcement back of the spike to prevent bending caused by lateral movement of the rail, and to minimize spike cutting caused by running rail, and insure the vertical driving of the spikes. For over two years this company has been successfully rolling at its mills at Portsmouth, Ohio, the Economy Tie Plate No. 9-R, which has in design and construction all the features required for a plate for the purpose. The illustrations show a plate with a strong main body, with a rail retaining shoulder, with elevated bosses rolled on the same angle as the flange of the rail, also bosses on the field end of the plate. These bosses provide bearing for the flange of the screw spike and



Economy Tie Plate.

give reinforcement to same preventing bending and cutting as before described. The spike holes in the bosses serve as guides or jigs when boring the ties after plates are in position under the rail, and prevent absolutely applying the spike improperly.

The plates are rolled from open hearth steel with four longitudinal or two transverse flanges on the bottom sur-



A. S. C. E. and A. R. A. Rails on Economy Tie Plates No. 9 R.

face, or with a flat bottom if desired. They can also be supplied for two, three or four hole punching. The Spencer Otis Co. has made a plate which gives the screw spike all the support required and has made probable the successful application and use of these spikes with the No. 9-R Economy Tie Plate, which is designed to accept A. S. C. E. and A. R. A. sections of rail of the same weight per yard.

ROCKFORD MOTOR CARS

Gasoline motor cars are effecting a material saving in the maintenance of way service, and one of these cars, the "Rockford," is being exhibited by the Duntley Manufacturing Co., Chicago, in booths 99 and 100. These cars eliminate chain, friction, or gear transmission of power, the connecting rods being direct connected to crank shaft. The engine is of the four cycle type with automatic intakes, having by way of valve gear a short transverse cam shaft which is driven by a light sprocket chain from the crank shaft, this cam shaft regulating the main exhaust valves, and also carrying the timer or commutator for the jump spark ignition system. Contrary to usual gas engine practice they use two exhausts, the main exhaust valve being in the head end of the cylinder, with an auxiliary exhaust on the under side at the far end of piston stroke. By this means the

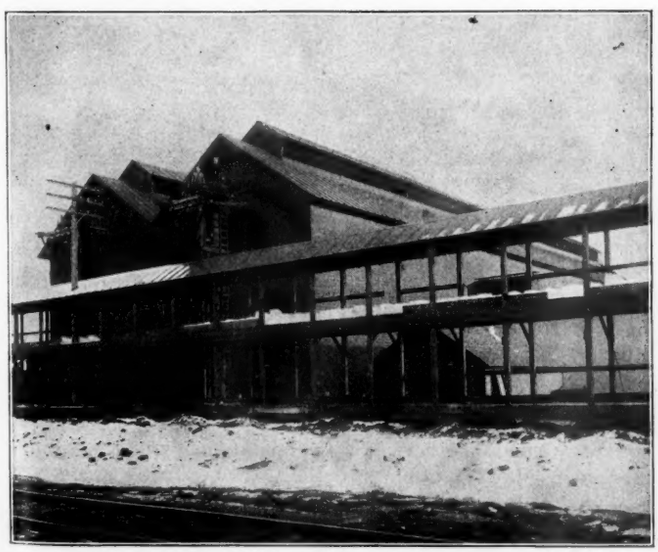
cylinders are throughly cleared of all dead gas and obtain the full efficiency of their next charge, at the same time reducing the chances of heating to a minimum. An extremely low compression is used, and as a result the cylinder temperature never rises to a point where a cooling device is required.

An important device is the lever which opens the main exhaust valves, thus destroying all compression and stopping the engine, and at the same time automatically checking the flow of oil to the cylinders, as there is no suction, in this way avoiding any waste of fuel or flooding of cylinders. By opening the exhaust valves and applying brake, the operator can slow down for all switches, interlockers, crossings and danger points, and it is only necessary to release the lever, closing exhaust valves, for the engine to again operate.

The carburator used on these cars is specially designed, is patented and is not on the market. It is so constructed that the gasoline and air are automatically proportioned, and then thoroughly mixed and vaporized, so the gas which is formed will produce a clean explosion, and eliminate the forming of carbon deposits. It is due to the quality of gas formed that these cars will run in the most severe cold of winter as well as in the summer, which is an important factor.

LITH BOARD.

The accompanying cut illustrates the ice making and storage plant of the Pacific Fruit Express Co., at Las Vegas, Nev., during construction. This is one of three concrete buildings for this company which are among the largest and most important ice storage houses in the United States. The insulation used in these buildings is three inches of waterproof lith, faced with two inches of cork board. The heat transmission of this type of construction is said to be less than 0.9 B. T. U. per sq. ft. per day per degree difference in temperature.



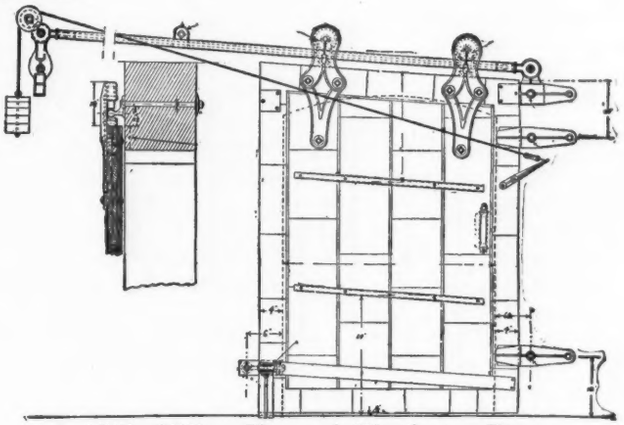
Precooling and Ice-Making Plant of Pacific Fruit Express Company at Las Vegas, Nev.

The lith board is applicable to ice houses of all types of construction, and in most climates the heavy coating used in the Las Vegas plant would be unnecessary. The heat transmission of the lith board alone is 1.6 B. T. U. per sq. ft. per day per degree.

This insulating material is one of the products of the Union Fibre Co., Winona, Minn., and is exhibited in booth 171 at the Coliseum.

ALLITH SLIDING FIRE AND WAREHOUSE DOOR HARDWARE.

The line of fire door hardware shown in Booth 116 by the Allith Manufacturing Company is applicable to sliding fire doors, to shutters for fire walls and to other similar openings.



Allith Sliding Fire and Warehouse Door.

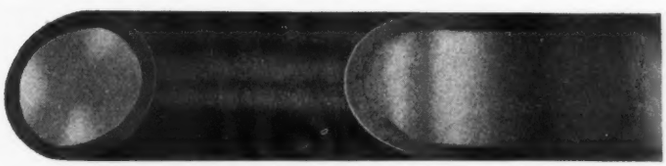
These products are regularly inspected and labeled under the supervision of the Underwriters' Laboratories, Inc., which are under the direction of the National Board of Underwriters.

COPPER-CLAD STEEL WIRE.

A material which is new, one which has passed through the experimental stage, and the durability, economy and adaptability of which has been established in the minds of those who have given it a thorough practical trial, is worthy of the attention of railway officers in charge of construction and maintenance.

For a number of years various companies have attempted to cover steel wire with copper. Electroplating, wrapping a copper strip on a steel wire, and slipping a copper sleeve over a steel billet and rolling and drawing it into wire, are some of the methods which have been tried. It is said that in every case the results were unsatisfactory. The cause seemed to be identical in all cases, namely: The copper and steel were not welded together. The electroplating would shell off; the copper sleeve would break under the influence of temperature changes, or the stripped wire would open up. In the latter two cases, electrolysis would set in and destroy the wire.

In order to weld the copper shell to the steel core, it is necessary first to form a copper-iron alloy on the surface of the steel billet, after which a copper coating can readily be welded to this alloy and the billet drawn into wire.



Section of "Copper Clad" Steel Wire.

This is the process used by the Duplex Metals Company, New York. The accompanying half-tone shows sectional views of a piece of this wire. On account of the very satisfactory weld between the steel core and the copper shell, the company has trade marked this product "Weld Clad." Since copper had a low tensile strength, to obtain a strong line with copper wire, it is necessary to string a larger size than would be necessary to meet the demand of the conductivity alone. Even in the best copper construction, the line is constantly sagging and stretching out, requiring

heavy maintenance expense for pulling up and repairing breaks. Copper-clad steel wire combines the strength of steel with the conductivity and noncorrosive properties of copper; hence its use effects a considerable saving in first cost, maintenance and renewal.

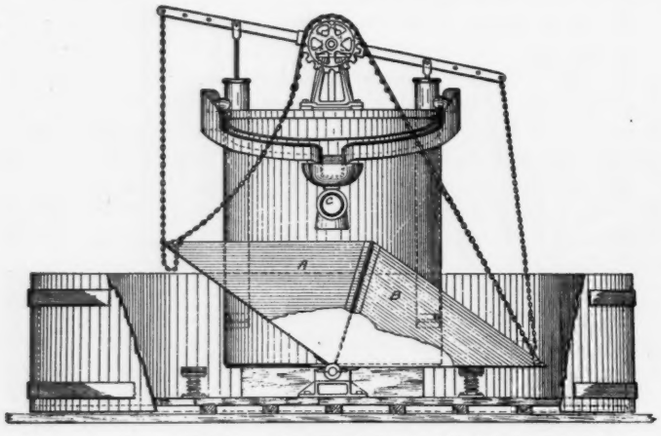
Copper-clad steel wire is especially adapted to signal service, where the size of the wire is usually based upon its tensile strength. Thus No. 10 wire is almost always used overhead, while No. 16 answers most cable purposes. The strength of No. 12 copper-clad is said to be much greater than that of No. 10 hard-drawn copper wire, while its conductivity is slightly better than No. 10 copper and its cost per mile about two-thirds that of copper. Copper-clad, though but 60 per cent. steel, is said to actually be stronger than galvanized wire of the same diameter. This is due to the working to which steel is subjected during the process of manufacture of the copper-steel wire rods, while galvanizing tends to reduce the tensile strength of a wire.

Copper-clad bond wires are now standard on many railway signal systems, as their conductivity is greater than that of galvanized, and they will not rust.

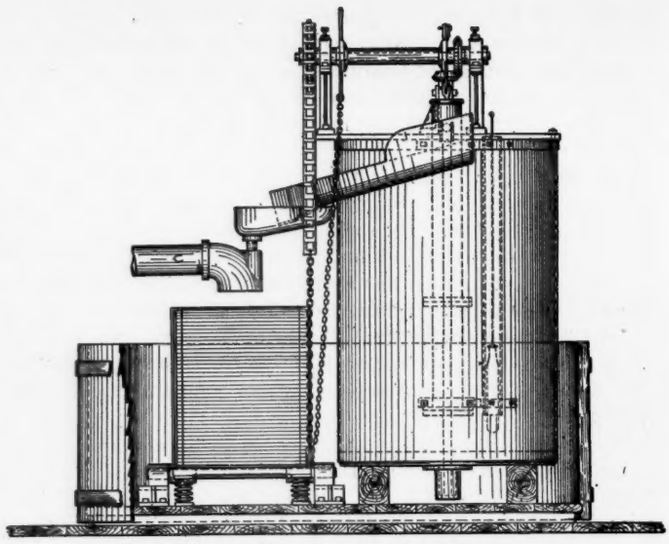
DAVIDSON PROPORTIONING MACHINE.

The Otto Gas Engine Works, 357 Dearborn street, Chicago, make a machine for use in water purification systems which automatically mixes a definite proportion of chemicals with the water without the use of power in excess of that required to pump the water.

To secure satisfactory water purification, it is necessary that the proper proportion of chemicals be thoroughly mixed with the water, and to accomplish this automatically a machine must accurately measure the water and the chemical, thoroughly mix the two, and in case the treatment is a mixture of two or more chemicals, keep this solution uniform. For the measurement of the water, the Davidson machine uses a tipping vessel divided in the center, and shown at AB in the accompanying cut. The raw water enters this vessel through the pipe C. When A is filled, the vessel tips, discharging the contents of A and presenting B for filling. When B is filled the vessel tips back and the operation continues. A pair of ball check pumps are used for measuring the chemical and a mechanical stirring device for its agitation. The two chains connected to the tipping vessel, as shown in the cut, operate these devices. When the vessel tips, a definite amount of the chemical is pumped and allowed to mix with the incoming water. At the same time, the solution is stirred by the action of the chain on the sprocket wheel shown, which is connected to the stirring device mentioned above.



Davidson Proportioning Machine.



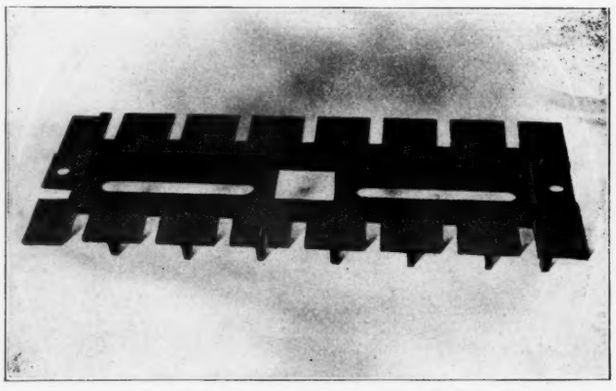
Davidson Proportioning Machine.

The mixture of the water and chemical is secured by the motion imparted to the incoming water by the shape of the vessel.

The machine is said to be positive and accurate in its operation, requires little inspection and is durable in construction.

UNIVERSAL PIPE LINE CARRIER BASE.

The Universal pipe line carrier base, illustrated herewith, is an improvement on the wooden bases so generally used that is in keeping with the adoption of concrete foundation blocks in signal practice. It is made of malleable iron, which practically eliminates the necessity for renewal. The ends are made as lap joints, so any number of bases can be joined together, and the slots for the anchor bolts are made long to allow the base to be fastened in any desired position on the foundation. This base is made by the W. K. Kenly Company, Chicago, and comes in five styles: One way, two way, three way, four way and six way.



Universal Pipe Line Carrier Base.

ADLAKE-SMALL TRAIN INDICATING LAMP.

The Adams & Westlake Co., Chicago, is showing in its exhibit booths, Nos. 83 and 84 the Adlake-Small train indicating lamp, which is designed for carrying train numbers, both regular and special, for day and night indications, rendering them easily read and thereby avoiding confusion or error.

The locomotive lamp is placed on the side of the boiler

back of the headlight, and in a position where the numbers are not dimmed by the light from the headlight. The lamp is placed at an angle so that the numbers are easily read by approaching as well as passing trains. Furthermore, this lamp is adaptable to caboose as well as other cars, so

Train Indicating Lamp.

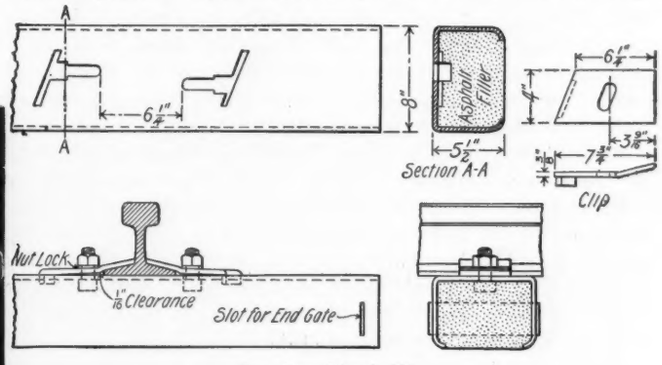
that similar signals may be carried at the rear as well as the front end of the train. The illumination of all of the figures is of uniform intensity, and as they are of ample size they are easily read both by day as well as by night.

These lamps have been adopted as standard by some of the most prominent railways and the comments concerning the results are extremely satisfactory as there is no occasion for an improper identification of trains.

SNYDER STEEL TIE.

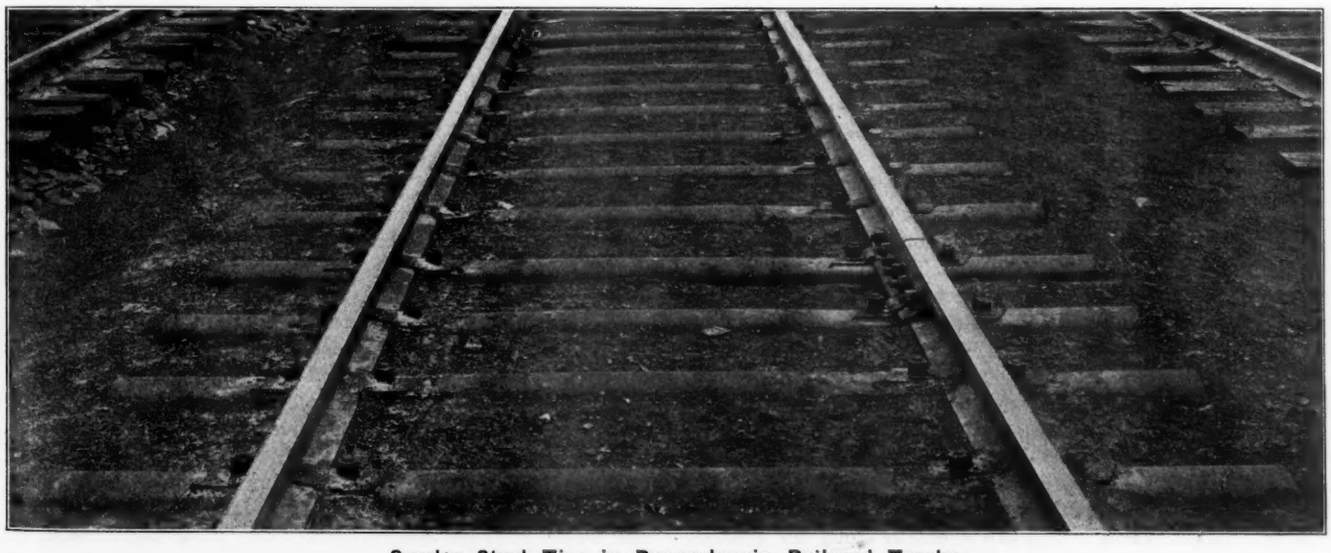
There are on exhibition at the Coliseum a number of Snyder steel ties taken from the Pennsylvania Railroad tracks at Conemaugh, Pa. This design has been in service for more than three years on the Pennsylvania Railroad, the Cornwall & Lebanon and other lines.

The standard type of Snyder tie has a steel casing 5-16-in. thick, 7 in. wide and 6 in. deep, with an open bottom. The casing is filled by hydraulic pressure with a mixture of asphalt and crushed stone. The sides are flanged inward on the asphalt filling and thus hold it in place, leaving a width of 5½ in. of the bottom of the tie exposed. This secures the same advantage as the wooden cross tie when embedded in ballast, the asphalt concrete taking hold of the ballast, the ballast imbedding itself into the filling, and preventing the tie from shifting any more than a wooden tie. The Snyder ties are especially adapted to perfect tamping for surfacing the track on account of the rounded corners. This



Snyder Steel Tie.

filling also takes up the vibrations and makes the track less rigid and more noiseless than with ties where only steel gets in contact with the ballast. The adjustable fastening of the rail to the tie is illustrated in the drawing. It can be adjusted to the gage of the track and fastens the rail to the tie with bolts more firmly and strongly than a rail can be secured to a wooden tie with spikes. It is expected that the life of ties made of 3-16 in. steel will not be less than 25 years and that the thicker ties will have correspondingly greater life. The Snyder tie, with complete fastenings, costs from $3 to $4, depending on the thickness. The weight of the standard tie is 600 lbs. The Pennsylvania Railroad reports that these ties continue to give satisfactory service in its Conemaugh and Derry yards. They are sold by the American Railway Steel Tie Company, Harrisburg, Pa., and made by the Central Iron & Steel Company, Harrisburg.



Snyder Steel Ties in Pennsylvania Railroad Tracks.

Fairbanks, Morse & Co., are inviting railway officers to make headquarters at their exhibit space, Nos. 35, 36, 37 54, 55, and 56, Coliseum, during the convention. The Fairbanks, Morse Co., are offering many conveniences to their railway friends, such as stenographer for private dictation, telegraph and telephone service and stationery.

BLUE AND WHITE PRINT PLANT.

The exhibit of automatic machinery by C. F. Pease Co., Chicago, in booths 161-164 includes the apparatus for making white prints which is in operation every afternoon and evening.

Engineers have long appreciated the value of these white prints over the ordinary blue prints for many purposes, but the labor and time involved by the negative process and the lack of uniform results has heretofore prevented their use to any large extent. The C. F. Pease Co. have perfected a process for making white prints direct from the tracing as quickly as blue prints, in one-fourth the time required to make a blue print from a negative.

While direct processes have been in use in a limited way for years the expense involved in handling the paper by hand and the irregularity of the results obtained have heretofore made the process impractical. The C. F. Pease Co., have invented and patented a special apparatus which makes this direct white print paper with as much uniformity as blue print, while unlike the blue print paper, which must be used very soon after coating, this white print paper will keep indefinitely. They have also patented a special apparatus which with their continuous printer and automatic washing and drying machine, enables them to make these white prints by one continuous operation as quickly as blue prints —printing, washing and drying, and delivering the finished prints at the end of the machine thoroughly dried and automatically wound up, ready for use. They are thus enabled to supply these prints any length in one piece, free from stick marks or distortion, and the smallest print can also be made with equal ease.

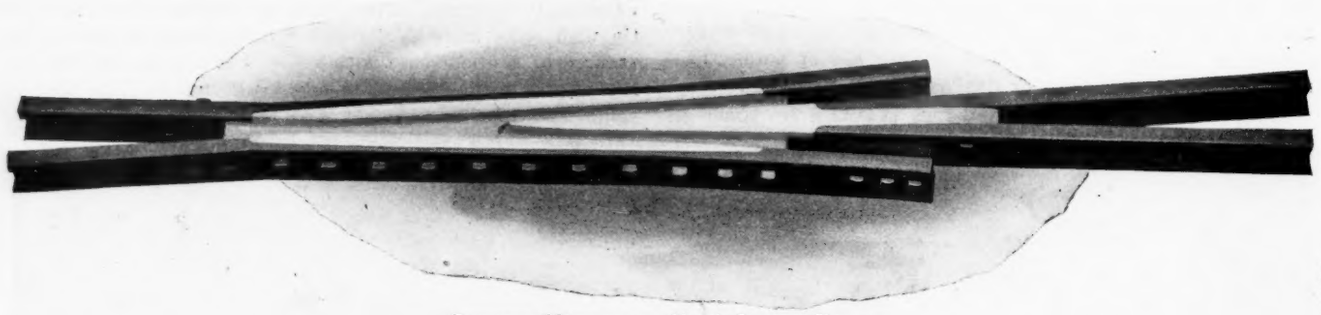
They claim for their white prints that they are absolutely fast color; that the strongest sunlight has no effect on them; that the high grade of paper which they use practically prevents shrinkage and does not distort in washing and drying; and that with their eradicating solution and special blue ink changes and additions can be made very readily. These white prints are specially good for profiles and field work, on account of the toughness of the paper, the non-fading quality of the print and the ease with which notations and changes can be made upon them. A print can be made from a print provided the original tracing has clear and reasonably strong lines. Reports, specifications and statistics printed from typewritten copy show up well while pencil sketches can be easily incorporated.

This company is prepared to do white printing quickly and in large volume, and are also putting their automatic machines on the market. They are also making a combination machine so that both blue prints and white prints can be made on the same equipment, changing from one to the other while the machine is in operation. They have placed their machines in the hands of quite a number of prominent railways and large corporations in the past year.

RAMAPO MANGANESE HARD CENTER FROG.

That an easy riding hard center frog, having long lapped joints with the connecting rail and a long uniform center casting, will give the best life, is the claim for the frog illustrated herewith and manufactured by the Ramapo Iron Works, Hillburn, N. Y.

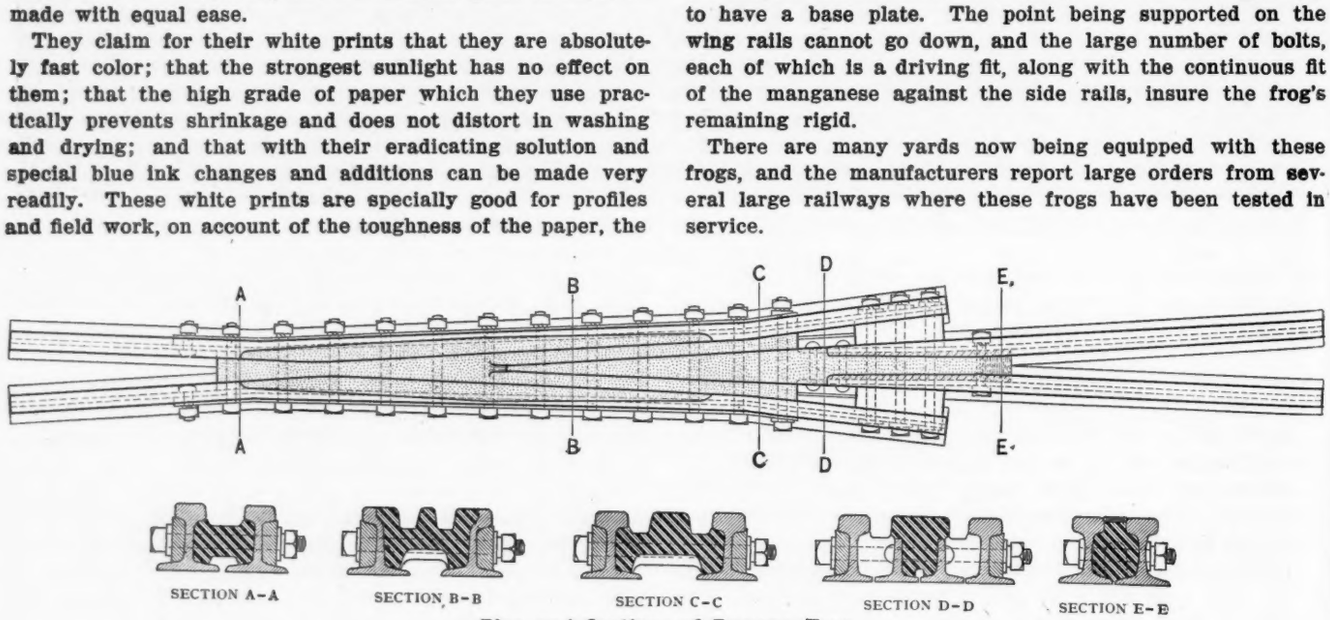
The illustrations show the construction of the frog, but attention is called to the fact that all points of hard service are well protected. The opening in the throat, which receives the wear from the wheel flange; the opening in the flare of the wing rail, which also receives the wear from the flange, and the filling in the heel end, which is subjected to wear from worn treads or double flange wheels, are all protected with manganese steel.



Ramapo Manganese Hard Center Frog.

A large number of bolts are used, and it is not necessary to have a base plate. The point being supported on the wing rails cannot go down, and the large number of bolts, each of which is a driving fit, along with the continuous fit of the manganese against the side rails, insure the frog's remaining rigid.

There are many yards now being equipped with these frogs, and the manufacturers report large orders from several large railways where these frogs have been tested in service.



Plan and Sections of Ramapo Frog.

FREELAND IMPROVED CLAMP DERAILER.

The Hobart-Allfree Co., Old Colony building, Chicago, has put on the market within the past year its improved Freeland derailer, which is on exhibition at the Coliseum, space 148.

Fig. 1 shows the derailer in closed position with only one connection used, and Fig. 2 shows the open position, the derailing block being protected from any dragging brake

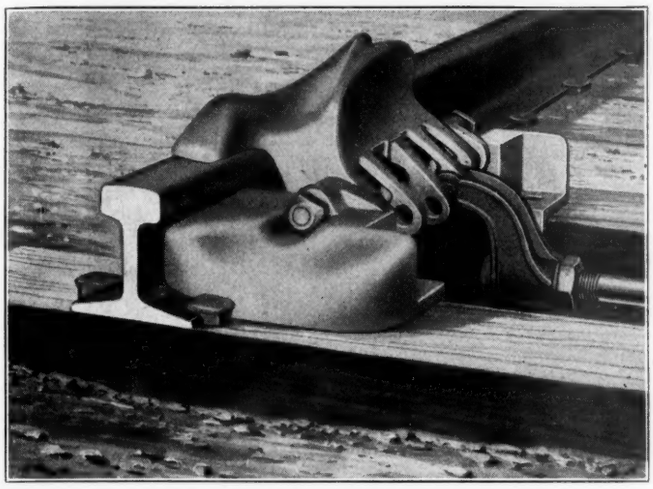


Fig. 1. Derailer in Closed Position.

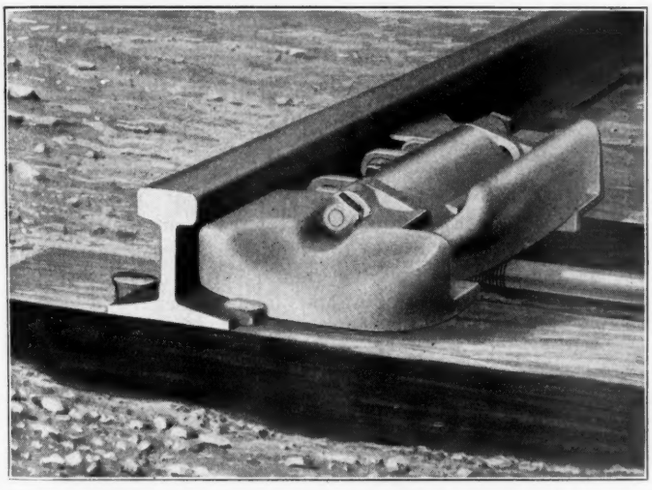


Fig. 2. Derailer in Open Position.

beams, by a part of the bracket which acts as a "derail protection."

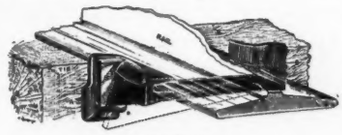
The Freeland derailer is so constructed that it can be operated by any mechanism or used as a hand-throw. It is in two parts and is easily operated. The lip or flange which extends down over the head of the rail is retained on this derailer, and takes the bulk of the strain in derailment, preventing any possibility of the derailer being forced off the rail.

ANTI-RAIL CREEPERS.

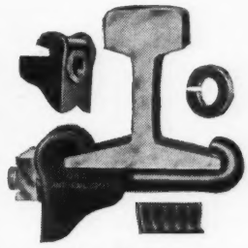
One of the phases of track maintenance which is perhaps at present receiving more attention than any other is the creepage of rails, which is one of the many evils to which railway track is subject.

Many devices have been tried to prevent this creepage. It has become very generally conceded that to properly perform its function, an anti-rail creeper should be fixed to the rail base only, having a lug or shoe casting which comes in contact with the tie and thus afford the resistance necessary to prevent creeping. Devices which are rigidly attached to both tie and rail move the tie back and forth with the creepage and contraction of the rail, which eventually loosens the ballast to such an extent that both tie and rail move. A device which has no provision other than pressure of creepage for retaining its grip on the rail is said to become loose and inoperative, or drop off of the rail entirely.

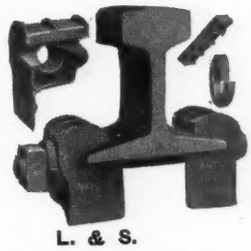
The Q. & C. Co. has spent much time and money in the development of anti-rail creepers, and the illustrations here-



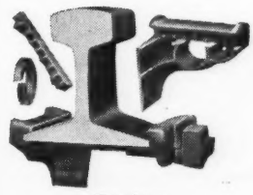
Vaughan.



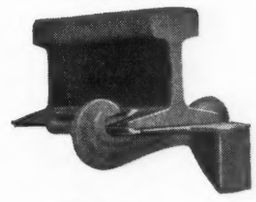
Q. & C.



L. & S.



Racine.



Murray.

Q. & C. Anti-Creepers.

with show those types designed to meet the varying conditions, and which may be applied to the rail or panel in any quantity.

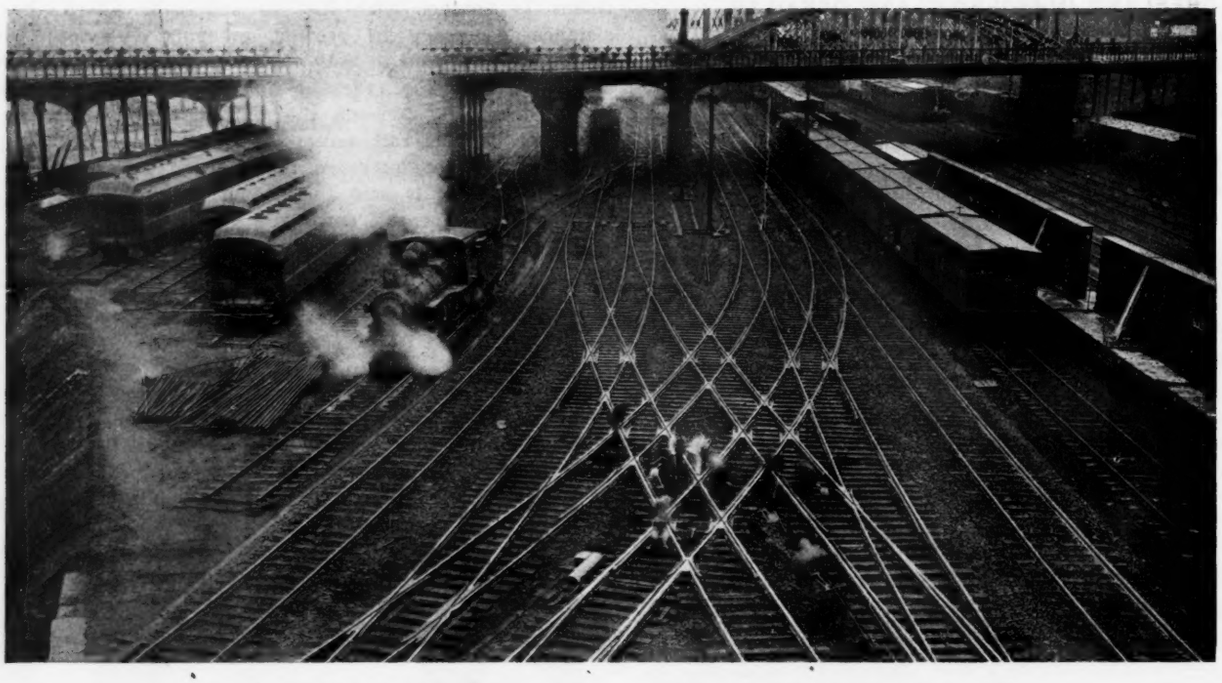
A full line of these various types is on exhibition at spaces 119-120 at the Coliseum, where the Q. & C. Co., New York, representatives will take pleasure in explaining their details.

TERMINAL LAYOUTS.

The frog and switch department of the Pennsylvania Steel Co., Steelton, Pa., has furnished track work for all the principal terminals in the East, including Pittsburgh, Philadelphia, Baltimore, Washington and New York. The accompanying illustrations show the magnitude of the work undertaken, and are sufficient assurance that the types of construction used have been approved by the railway engineers. The material in these layouts is Manard steel; the hard center frogs, crossings and knuckle rails are all exclusively of Pennsylvania Steel Co. design, embodying the latest improvements in work of this character.

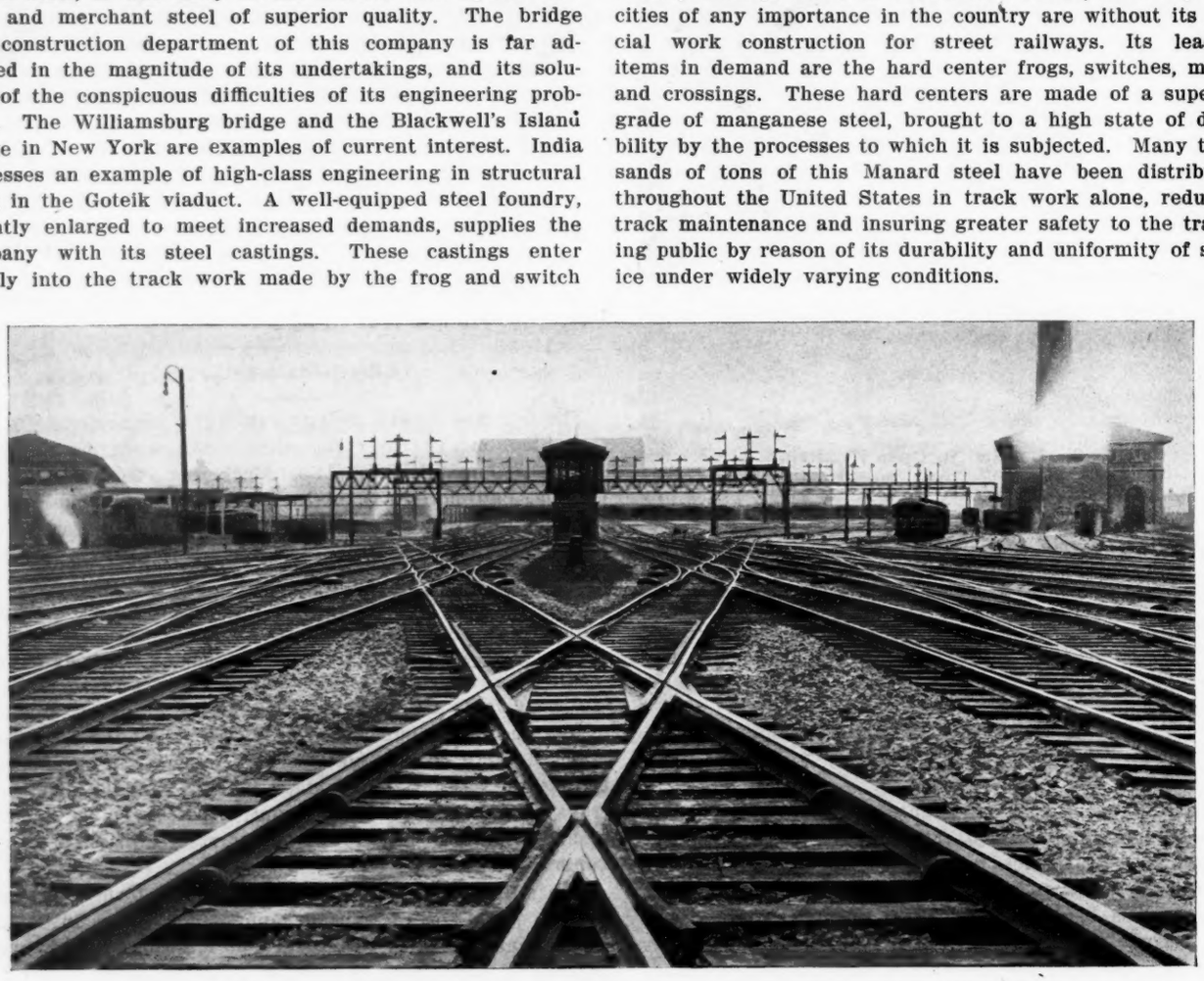
Pennsylvania enjoys a world-wide reputation as the nursery of the steel industry. Her mines and mills have contributed more to the material advancement of the nation than those of any other state in the Union. The great transportation lines of the country were possible achievements only by reason of the great steel mills of Pennsylvania.

The mills of the Pennsylvania Steel Co. form a crescent on the banks of the Susquehanna three miles in length. This plant owns its own coal and ore mines and every process of production is directed and controlled under the supervision of its engineers and skilled workers. Its rail

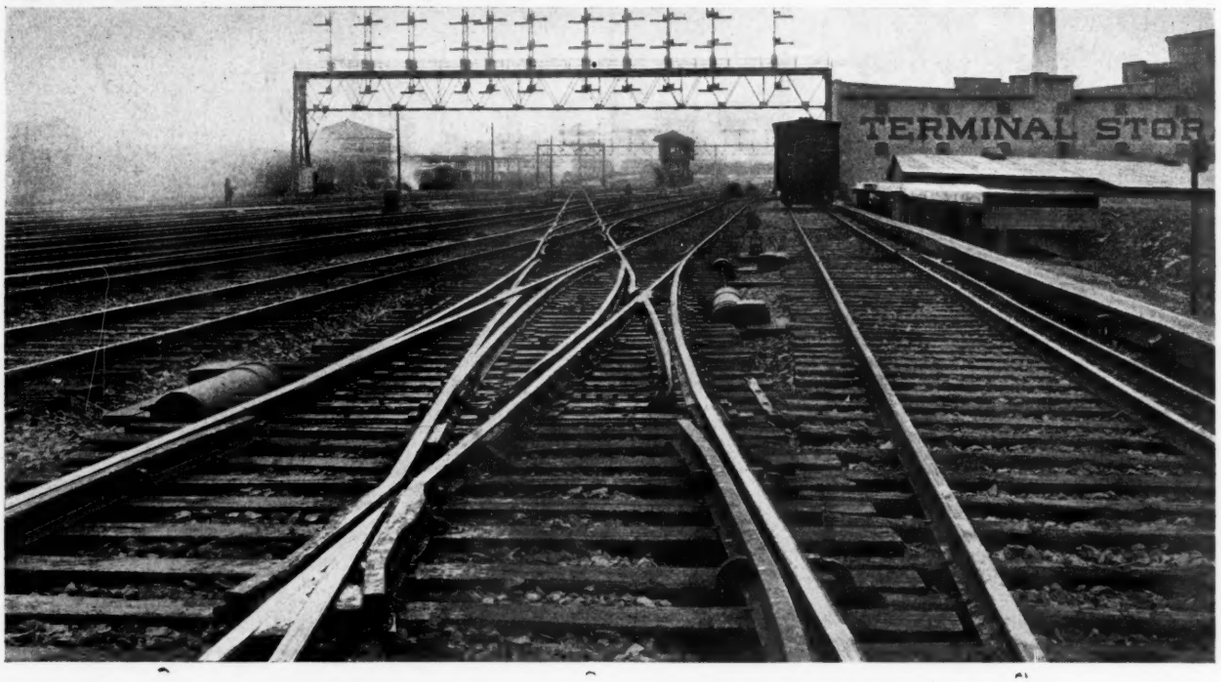


Track Layout (Manard Construction) East of Union Station, Baltimore, Md.

mill is one of the few mills turning out girder and high T rails. It has a blooming mill, a billet mill and a slab mill. With a thorough and full equipment for making open-hearth steel, it was early in the market with open-hearth rails and merchant steel of superior quality. The bridge and construction department of this company is far advanced in the magnitude of its undertakings, and its solution of the conspicuous difficulties of its engineering problems. The Williamsburg bridge and the Blackwell's Island bridge in New York are examples of current interest. India possesses an example of high-class engineering in structural work in the Goteik viaduct. A well-equipped steel foundry, recently enlarged to meet increased demands, supplies the company with its steel castings. These castings enter largely into the track work made by the frog and switch department, the largest manufacturing plant of its character in the world. Track material of all kinds is shipped to all points of the compass. Its product is in demand on every railway of importance in the United States, and very few cities of any importance in the country are without its special work construction for street railways. Its leading items in demand are the hard center frogs, switches, mates and crossings. These hard centers are made of a superior grade of manganese steel, brought to a high state of durability by the processes to which it is subjected. Many thousands of tons of this Manard steel have been distributed throughout the United States in track work alone, reducing track maintenance and insuring greater safety to the traveling public by reason of its durability and uniformity of service under widely varying conditions.



Track Layout (Manard Construction) Approaching Station, Washington, D. C.

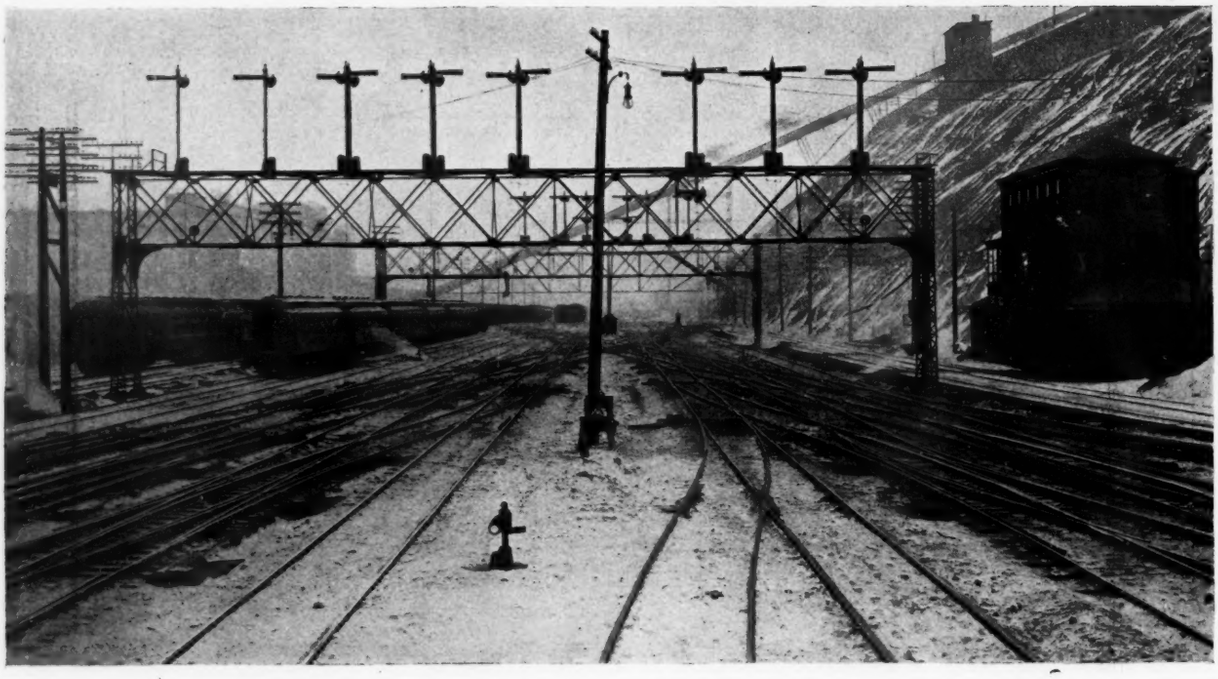


Slips in Terminal, Showing Manard End Frogs, Design No. 153, Washington, D. C.

The Manard anvil face frog, design 160, is the high development of the steam railway frog adapted to high speeds and heavy traffic. A solid Manard center embracing the point and also the wings of the frog where they are subjected to the irregular shocks of false flanges is extended back to form a heel block that acts as a pick-up and reduces the shock on the carbon rails abutting on the Manard center. The frog is equipped with Never-Turn split bolts, a recent improvement in bolt construction that has already proved a potent factor in the prolongation of the life of the frog, and is a welcome relief to every track foreman from the monotonous and ever-recurring necessity of tightening up frog bolts. This bolt has an elongated head, which fits head and flange of rail, thus preventing the bolt from turning. The end of the bolt is split and the split is closed before the bolt is threaded. When the nut is placed the split is opened, thus firmly engaging the threads of the nut and the bolt. If it is found necessary to remove the nut, it can be replaced and the split reopened a number of times. The customary susceptibility of bolts to the vibration of traffic is not apparent in this bolt. Every railway man knows that tight nuts mean the maximum of service and the assurance of safety. In connection with the Never-Turn bolt a special long nut is furnished, as the absence of nutlocks makes it desirable that the nut shall project sufficiently to secure a good holding surface with a wrench. A totally new departure in a nut fastening is now under consideration by the officials, and it is expected to market this development in the very near future.

The Never-Slip interlock switch plate is also solely the

Track Layout (Manard Construction) East of Union Station, Pittsburgh, Pa.



Track Layout (Manard Construction) East of Union Station, Pittsburgh, Pa.

product of this company. This plate is rolled from a special steel and has replaced the old type of struck-up riser plate. It is a solid plate ⅝ in. thick, with riser of required height, and is practically a rail lock.

The Rapid Renewable hard center frog is fulfilling all expectations in its wide use on street railways during the last four years. The Manard center is set on a cast-iron bed of sufficient strength to resist the heaviest loads. Projecting lugs or feet on the bottom of the center are engaged with Tobin bronze bolts that will not rust. All strains are carried to the center of the frog, and the center can be removed from the frog in a few minutes without disturbing the pavement.

One of the most interesting shops in the frog and switch department is the switch stand shop, where mechanical signaling devices are constructed. The New Century switch stand of adjustable and non-adjustable types, both positive and automatic in action, are made here. The adjustable New Century switch stand has met with universal favor. It is adapted to any service. The facing point lock with distant signaling attachment is a high development of mechanical signaling. The processes in this shop insure mechanical accuracy of construction and first-class workmanship. Forgings, castings, machined parts and all accessories to track maintenance are turned out in large quantities in the frog and switch department.

Manard Knuckle Rails and Movable Points, as Applied to Slip Crossings, in Terminal Union Station, Pittsburgh, Pa.